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Radioactive Air Emissions Notice of Construction for the T Plant Complex Fuel Removal Project

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TERMS

ALARACT	as low as reasonably achievable control technology
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
BARCT	best available radionuclide control technology
Ci	curie
CSB	Canister Storage Building
DOE-RL	U.S. Department of Energy, Richland Operations Office
HEPA	high-efficiency particulate air
LIGO	Laser Interferometer Gravitational Wave Observatory
MEI	maximally exposed individual
mrem	millirem
NOC	notice of construction
PWR-2	Pressurized Water Reactor Core 2
SEPA	*State Environmental Policy Act*
SNF	spent nuclear fuel
SSFC	Shippingport Spent Fuel Container
TEDE	total effective dose equivalent
µCi/ml	microcuries per milliliter
WAC	Washington Administrative Code
WDOH	Washington State Department of Health

METRIC CONVERSION CHART

Into metric units — Out of metric units

If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0393	inches
inches	2.54	centimeters	centimeters	0.393	inches
feet	0.3048	meters	meters	3.2808	feet
yards	0.914	meters	meters	1.09	yards
miles	1.609	kilometers	kilometers	0.62	miles
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
acres	0.404	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.0352	ounces
pounds	0.453	kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
Volume			**Volume**		
fluid ounces	29.57	milliliters	milliliters	0.03	fluid ounces
quarts	0.95	liters	liters	1.057	quarts
gallons	3.79	liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76456	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.948	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds per square inch	6.895	kilopascals	kilopascals	0.14504	pounds per square inch

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.

NOC HISTORY

The current mission of the T Plant Complex is for treatment and storage of liquid mixed waste, storage of contaminated process equipment, decontamination of equipment and materials, and storage, treatment, and repackaging of containerized waste. This mission has been ongoing since before issuance of Washington Administrative Code (WAC) 246-247. A Notice of Construction (NOC) has not been required previously for the T Plant Complex, with the exception of the NOC submitted for the upgrades to the 2706-T Building (Project W-259).

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RADIOACTIVE AIR EMISSIONS NOTICE OF CONSTRUCTION FOR THE T PLANT COMPLEX FUEL REMOVAL PROJECT

This NOC describes the activities to remove all spent nuclear fuel (SNF) assemblies from the spent fuel pool in the T Plant Complex 221-T canyon for interim storage in the Canister Storage Building (CSB). The unabated total effective dose equivalent (TEDE) estimated for the public hypothetical maximally exposed individual (MEI) is 1.6 E-5 millirem (mrem) per year for this fuel removal NOC. The abated TEDE conservatively is estimated to account for 8.0 E-9 mrem per year to the MEI.

The following text provides information addressing the requirements of Appendix A of WAC 246-247 (requirements 1 through 18), and of the 40 Code of Federal Regulations (CFR) 61.07.

1.0 LOCATION

Name and address of the facility, and location (latitude and longitude) of the emission unit:

U.S. Department of Energy, Richland Operations Office
Hanford Site,
Richland, Washington

221-T Building, 200 West Area
Latitude: 46° 33' 40.7" N
Longitude: 119° 37' 2.2" W

Figure 1 shows the location of the T Plant Complex within the 200 West Area. The exhaust stack is identified as the 291-T-1 Stack.

2.0 RESPONSIBLE MANAGER

Name, title, address and phone number of the responsible manager:

Mr. G. H. Sanders, Director,
Waste Management Division
U.S. Department of Energy, Richland Operations Office
P.O. Box 550
Richland, Washington 99352
509-372-1786

3.0 PROPOSED ACTIONS

Identify the type and proposed action for which this application is submitted.

The proposed action is considered an insignificant modification to an emission unit (291-T-1).

.1 FUEL ASSEMBLIES AT THE T PLANT COMPLEX

The 221-T canyon cell 2R contains Pressurized Water Reactor Core 2 (PWR-2) fuel assemblies that were irradiated in an experimental reactor in Shippingport, PA from 1965 to 1974. These blanket fuel assemblies absorbed the neutron flux from the seed assemblies and bred plutonium. Although these blanket fuel assemblies could not sustain a criticality on their own, these fuel assemblies were located within the reactor with highly enriched seed fuel assemblies. The blanket fuel assemblies were transferred to the spent fuel pool in the 221-T canyon at the T Plant Complex in 1977 and 1978 for reprocessing to recover produced plutonium. The reprocessing operations never were initiated and the fuel assemblies have remained in storage in the 221-T cell 2R, spent fuel pool.

There are 72 PWR-2 fuel assemblies in the 221-T spent fuel pool. Each fuel assembly is 3.6 meters long and has a square cross-section of 19 centimeters as shown in Figure 2. The fuel in the assemblies is natural uranium oxide (UO_2), with Zircaloy-4 cladding. The cladding confines the radionuclides (fission products, activation products, and actinides) present in the fuel assemblies, and prevents potential emissions from being released. External surface contamination on the assemblies, known as crud, is the material with a potential for radioactive air emissions.

A detailed description of the fuel is provided in the *Shippingport PWR Core 2 Blanket Assemblies Source Term Calculations Using ORIGEN2* (HNF-SD-SNF-TI-061).

.2 SCOPE OF FUEL REMOVAL PROJECT

The scope of the T Plant Complex Fuel Removal Project includes all activities required to prepare for, and perform fuel handling, canister loading, canister drying and inerting, and cask loading within the 221-T canyon, and subsequent cask transportation to the CSB. The physical work activities required for fuel removal include the following:

- Retrieval of PWR-2 fuel assemblies (Figure 3) from their current pool storage racks in the 221-T Building

- Insertion of PWR-2 fuel assemblies into Shippingport Spent Fuel Containers (SSFCs) (Figures 4) and closure with shield plugs (Figure 5)

- Fuel conditioning (i.e., drying and inerting) within the SSFCs

- Transfer of the SSFCs to the CSB.

4.0 STATE ENVIRONMENTAL POLICY ACT

If the project is subject to the requirements of the State Environmental Policy Act (SEPA) contained in chapter 197-11 WAC, provide the name of the lead agency, lead agency contact person, and their phone number.

The proposed action categorically is exempt from the requirements of SEPA under WAC 197-11-845.

5.0 CHEMICAL AND PHYSICAL PROCESSES

Describe the chemical and physical processes upstream of the emission unit.

The chemical and physical processes associated with the T Plant Complex Fuel Removal Project will consist of the following.

- Because the spent fuel pool water has remained relatively clean and there has been no indication of fuel cladding failure (verified by monthly sampling of the pool water), the pool filtration system has not been used for years. The pool filtration system will be reactivated and placed in service before removal of the fuel assemblies to increase water clarity.

- The SSFCs (with inserts installed), shield plugs, shield plug seals, and required tools will be staged at the T Plant Complex. The skid-mounted fuel conditioning system will be placed in the 221-T tunnel.

- The SSFC/cask/transporter will be moved into the 221-T tunnel and the loading guide will be installed into the SSFC.

- The hoist will be moved to the spent fuel pool using the canyon bridge crane to position. The fuel assembly will be grappled remotely, raised from the pool, and the fuel assembly identification number will be recorded (Figures 6 and 7).

- The fuel assembly will be transferred over the cell partition and lowered into the SSFC. After four fuel assemblies are placed into an SSFC, the shield plug will be installed and the SSFC will be sealed mechanically. The SSFC identification number associated with the fuel assembly identification numbers will be recorded.

- The SSFC will remain on the transporter trailer during loading and conditioning operations within the fuel transport cask, and will be connected to the fuel conditioning system (Figure 8) via the process port on the shield plug (Figure 5). The SSFC will be conditioned by pulling a vacuum to dry the fuel, backfilling with helium, pulling a vacuum again, and refilling the SSFC with helium to inert the fuel. The SSFC will be leak tested to verify closure and the process port cover plate will be closed.

- The cask lid will be placed on the cask and bolted in place (airtight) and the cask will be transported to the CSB. After off-loading the SSFC at the CSB, the cask and transporter will be returned to the 221-T tunnel. It will take 18 trips to transfer the 72 fuel assemblies. The fuel transport cask (same type used to transport K Basin Fuel multicanister overpacks) is designed to preclude the potential release of radioactive emissions.

- The fuel conditioning system skid will be dismantled and removed from the 221-T canyon.
- The pool water will be pumped out and transferred (e.g., tanker trucks or hard piping) to a permitted liquid waste treatment/disposal facility.
- Decontamination of the spent fuel pool will not be part of the scope of this NOC.

6.0 PROPOSED CONTROLS

Describe the existing and proposed abatement technology. Describe the basis for the use of the proposed system. Include expected efficiency of each control device, and the annual average volumetric flow rate in cubic meters/second for the emission unit.

The existing 221-T ventilation system will be used (291-T-1 Stack). Two stages of high-efficiency particulate air (HEPA) filters are tested in place annually at a minimum control efficiency of 99.95 percent. Currently, the annual average flow for the 291-T-1 Stack is 15 cubic meters per second.

7.0 DRAWINGS OF CONTROLS

Provide conceptual drawings showing all applicable control technology components from the point of entry of radionuclides into the vapor space to release to the environment.

Figure 9 shows the existing ventilation system for the 291-T-1 Stack.

8.0 RADIONUCLIDES OF CONCERN

Identify each radionuclide that could contribute greater than ten percent of the potential to emit TEDE to the MEI, or greater than 0.1 mrem/yr potential to emit TEDE to the MEI.

Any radionuclide might be present in the T Plant Complex from historical operations. The 291-T-1 Stack is designated as a minor stack that currently requires periodic confirmatory measurements for total alpha and total beta/gamma. Although the fuel assemblies have a total inventory of 1.9 E+6 Ci (actinides, fission products, and activation products, decayed to 2001), the radionuclides in the spent fuel are confined by the cladding and are not subject to potential release. The radionuclides of concern for this fuel removal project NOC are iron-55, cobalt-60, nickel 63, strontium-90, and plutonium-238 from the crud (external surface contamination on the fuel assemblies) and cobalt-60 and cesium-137 in the pool water.

9.0 MONITORING

Describe the effluent monitoring system for the proposed control system. Describe each piece of monitoring equipment and its monitoring capability, including detection limits, for each radionuclide that could contribute greater than ten percent of the potential to emit TEDE to the MEI, or greater than 0.1 mrem/yr potential to emit TEDE to the MEI, or greater than twenty-five percent of the TEDE to the MEI, after controls. Describe the method for monitoring or calculating those radionuclide emissions. Describe the method with sufficient detail to demonstrate compliance with the applicable requirements.

The proposed operations will be subject to periodic confirmatory measurement requirements specified in 40 CFR 61.93 and WAC 246-247. In accordance with these requirements, periodic confirmatory measurements will be performed to verify low emissions and to support an estimate of the quantity of those emissions for annual reporting purposes. The record sampler for the 291-T-1 Stack typically is operated continuously, and particulate sample air filters are collected biweekly. At a minimum, four samples are selected (minimum of one sample per calendar quarter) and analyzed for gross alpha/beta activity to provide periodic confirmatory measurements to verify low emissions. The emissions during the proposed activity will be represented by these samples.

Water quality of the spent fuel pool currently is being monitored monthly for cobalt-60 and cesium-137. This practice will continue until all of the fuel assemblies have been removed from the pool. T Plant Complex procedures establish specification limits for spent fuel pool water quality, including a requirement to operate the ion exchange system if total cobalt-60 and cesium-137 levels exceed 0.01 microcuries per milliliter (µCi/ml). The specification limits are established to control corrosion of the fuel storage rack, support structures and fuel cladding, to provide indication of fuel cladding breach, to detect the potential for algae growth, and to provide an indication of proper operation of the ion exchange system.

The ion exchange system has not operated for several years, as water quality has remained well below the specification limits. During the period of February 1998 to November 2000, when the ion exchange system did not operate, the total cobalt-60 and cesium-137 levels ranged from 2.60 E-06 µCi/ml to 1.05 E-04 µCi/ml, with an average of 6.35 E-05 µCi/ml.

10.0 ANNUAL POSSESSION QUANTITY

Indicate the annual possession quantity for each radionuclide.

Table 1 summarizes the inventory at the T Plant Complex addressed by this fuel removal project NOC.

10.1 FUEL ASSEMBLIES

The 1.9 E+6 Ci inventory (decayed to 2001) of the 72 fuel assemblies is confined by the cladding, which has demonstrated good integrity. The cladding thickness on the blanket fuel assemblies still conformed to the as-built tolerances prior to shipment to the T Plant Complex (WAPD-LP[CES]-105).

"With respect to corrosion, for all practical fuel handling purposes, corrosion effects are negligible. The cladding thickness on PWR-2 spent blanket modules still conforms to as-built tolerances, as shown on W drawing 921J962, a copy of which was provided to Mr. Szempruch on October 12, 1977."

Water quality has been monitored during the entire storage history of the spent fuel pool. There has been no evidence that would indicate any loss of cladding integrity. During the three-year period described in Section 9.0, the cesium-137 results (best indication of cladding integrity) were near or below instrument detection levels. There is no credible scenario to release this inventory (i.e., less than 1 percent probability). The fuel assemblies have been in the T Plant Complex since 1978, and there will be no change in potential emissions resulting from removal of the fuel assemblies.

10.2 CRUD ACTIVITY

Surface build-up of iron particles on fuel assemblies (referred to as "crud") occurs in reactor operations. The crud deposits are formed from the high pressure and temperature in an operating reactor core, where iron deposits are transferred from the coolant piping to the reactor core elements, similar to hard water scale formation. The crud deposits become radioactive through activation during reactor operations. The crud on the blanket assemblies was formed during the reactor operations and is firmly attached, i.e., the blanket assemblies arrived at the T Plant Complex with the crud that is still present. Water quality data (Co-60 levels described in Section 9.0) has also demonstrated that the crud is still firmly attached to the cladding on the fuel plates inside the fuel assemblies.

The crud thickness can be measured by photogrammetry, which applies aerial mapping stereophotographic techniques to crud evaluation. Descaling, involving a rigorous four-step sequential method, which chemically strips the crud from the cladding on a fuel plate, is required to remove the crud for analysis of crud activity. Total crud on the 72 PWR-2 blanket assemblies stored at the T Plant Complex was minimal (a maximum of 13 micrometers thick and approximately 4 grams total weight (WAPD-335, Appendix B).

The quantity of crud activity on the blanket assemblies was estimated based on an analysis of a seed assembly from the 1969 refueling of the Shippingport reactor (WAPD-MT[CRCT]-45). Crud activity (decay corrected to 2001) was estimated at 1.2 E-6 microcuries per square decimeter ($\mu Ci/dm^2$) for iron-55, 2.2 E-5 $\mu Ci/dm^2$ for cobalt-60, 7.2 E-6 $\mu Ci/dm^2$ for nickel-63, 2.60 E-7 $\mu Ci/dm^2$ for strontium-90, and 3.24 E-7 $\mu Ci/dm^2$ for plutonium-238. The estimate was based on a total blanket surface of 1,870 dm^2 for 76 blanket assemblies. Because there are 72 blanket assemblies stored at the T Plant Complex, the total crud activity for each radionuclide is the concentration multiplied by the surface area (1,870 dm^2 x 72/76). Results of those calculations are shown in Table 1.

10.3 SPENT FUEL POOL WATER ACTIVITY

The 221-T spent fuel pool has a capacity of 190,000 liters. The pool water chemistry and depth have been maintained and monitored while the PWR-2 fuel has been in storage. There has been no significant increase in radionuclide concentration in the pool water, evidencing that the integrity of the fuel cladding is intact and that the crud is still firmly attached. The average cobalt-60 concentration of the pool water during the three-year period described in Section 9.0 was 6.12 E E-5 $\mu Ci/ml$. The average cesium-137 concentration during the same three-year period was 2.30 E-6 $\mu Ci/ml$, conservatively using instrument detection limits when cesium-137 was not detected (85 percent of the samples). This inventory is included in Table 1.

11.0 PHYSICAL FORM

Indicate the physical form of each radionuclide in inventory: Solid, particulate solids, liquid, or gas.

The physical form of each radionuclide of concern in the inventory is listed in Table 1.

12.0 RELEASE FORM

Indicate the release form of each radionuclide in inventory: Particulate solids, vapor or gas. Give the chemical form and ICRP 30 solubility class, if known.

All emissions from the radionuclides in the inventory presented in Table 1 are assumed released as particulate solids.

13.0 RELEASE RATES

Give the predicted release rates without any emissions control equipment (potential to emit) and with the proposed control equipment using the efficiencies described in subsection (6) of this section. Indicate whether the emission unit is operating in a batch or continuous mode.

The predicted release rates for each radionuclide, without any emissions control equipment (unabated), are presented in Table 1 using the appropriate WAC 246-247-030 (21)(a) release fractions (1.0 E-3). The total potential release rates for the radionuclides of concern (unabated) are summarized in Table 2. The predicted release rates using the control equipment efficiencies in Section 6.0 (abated) also are presented in Table 2. The fuel inventory described in Section 10.1 is confined by the cladding on the fuel plates within the fuel assemblies. There is no potential for airborne release from the blanket assemblies with intact cladding (evidenced by water quality data); therefore, a release fraction of zero is proposed for the fuel assemblies, and the inventory is not included in Table 1 or Table 2.

Actual emissions for 1999 from the 291-T-1 Stack were 3.7E-5 Ci of total alpha and 1.3 E-4 Ci of total beta/gamma. The 291-T-1 Stack will operate in continuous mode; however, the proposed activities in this NOC are not expected to result in a measurable change of actual emissions from the 291-T-1 Stack.

14.0 LOCATION OF MAXIMALLY EXPOSED INDIVIDUAL

Identify the MEI by distance and direction from the emission unit.

The MEI from the T Plant Complex is located at the Laser Interferometer Gravitational Wave Observatory (LIGO), approximately 18.3 kilometers east southeast of the Reduction Oxidation Facility (S Plant), conservatively chosen to represent 200 West Area. Dose estimates for unit Ci releases of selected radionuclides were calculated for emissions from the 200 West Area of the Hanford Site. These estimates were provided by e-mail (PNNL 2000a and PNNL 2000b), where the doses were calculated for an onsite member of the public working at LIGO. The dose calculations, Hanford defaults, and unit dose factors are provided in Attachment 1. A representative synopsis report (for the worker data set 1 file, out of 44 files) is provided in Attachment 2.

15.0 TOTAL EFFECTIVE DOSE EQUIVALENT TO THE MAXIMALLY EXPOSED INDIVIDUAL

Calculate the TEDE to the MEI using an approved procedure. For each radionuclide identified in sub section (8) of this section, determine the TEDE to the MEI for existing and proposed emission controls, and without any existing controls using the release rates from subsection 13 of this section. Provide all input data used in the calculations.

The calculations are summarized in Table 2. The total unabated dose for this NOC conservatively is estimated to be 1.6 E-5 mrem per year to the MEI, with a total abated dose estimate of 8.0 E-9 mrem per year to the MEI.

16.0 COST FACTOR IF NO ANALYSIS

Provide cost factors for construction, operation and maintenance of the proposed control technology components and the system, if a BARCT or ALARACT demonstration is not submitted with the NOC.

Pursuant to WAC 246-247-110, App. A (16), cost factors for construction, operation, and maintenance of proposed technology requirements are not required, as the following discussion is provided as an as low as reasonably achievable (ALARACT) demonstration.

The Washington State Department of Health (WDOH) has provided guidance that HEPA filters are generally considered best available radionuclide control technology (BARCT) for particulate emissions (Letter, AIR 92-107, A. W. Conklin, Washington State Department of Health, to J. D. Bauer, U.S. Department of Energy, Richland Operations Office, no subject, October 5, 1992). Control technology that meets BARCT requirements also meets ALARACT requirements. Because the radionuclides of concern are particulates, it is proposed that the controls described in Section 6.0 for the 291-T-1 Stack be accepted as ALARACT.

17.0 DURATION OR LIFETIME

Provide an estimate of the lifetime for the facility process with the emission rates provided in this application.

The removal of the fuel assemblies is scheduled to start in November 2001, and all of the assemblies will be removed before 2004.

18.0 STANDARDS

Indicate which of the following control technology standards have been considered and will be complied with in the design and operation of the emission unit described in this application:

ASME/ANSI AG-1, ASME/ANSI N509, ASME/ANSI N510, ANSI/ASME NQA-1, 40 CFR 60, Appendix A Methods 1, 1A, 2, 2A, 2C, 2D, 4, 5, and 17, and ANSI N13.1

For each standard not so indicated, give reasons to support adequacy of the design and operation of the emission unit as proposed.

The abatement control system for the 291-T-1 Stack was installed in the early 1990's before this requirement for control technology standards was specified in WAC 246-247 (April 1994). Although the listed technology standards, if available at time of construction, might have been followed as guidance, there was no regulatory requirement for compliance with the listed standards. Operational history, routine maintenance, testing, and inspections (ANSI N509 and N510) demonstrate adequacy of the design and operation of the existing abatement control technology as proposed. A summary is provided in Table 3 of the standards and the status of conformance by the ventilation and monitoring systems. Cited documents will be provided to WDOH on request.

- <u>ASME/ANSI AG-1</u>:

The 291-T-1 Stack and ventilation system were built before compliance with the code was required. Regarding the section in AG-1 on HEPA filters, the HEPA filters in the ventilation system for the 291-T-1 Stack meet all but two criteria dealing with filter qualification testing. Justification for these sitewide exceptions was discussed with and approved by WDOH at the December 1998 Routine Technical Assistance Meeting. A WDOH approved temporary deviation currently is in place to satisfy this issue (WDOH AIR 99-507). Other sections in AG-1 either are not applicable (e.g., adsorbers or moisture separators) or are addressed under ANSI N509.

- <u>ASME/ANSI N509</u>:

The HEPA filters conform to ANSI N509, Section 5.1. Documentation to show full compliance with the remaining sections of ANSI N509 cannot be provided. Instead, the following information is provided to support adequacy of design.

The 291-T-1 ventilation system was built when Hanford Plant Standard (HPS-157-M), *Standard Specification for Fire- and Moisture- Resistant Nuclear Grade HEPA Filters*, was in effect that covered fire resistance, moisture resistance, filter efficiency (penetration), flow resistance, and filter frame integrity. Although vendor provided documentation does not reference ANSI N509, many aspects of N509 requirements were considered in the design, evidenced by certifications for materials, welds, and housing leak tests

Two older fans (in series) were incorporated into the ventilation system upgrade (early 1990's). A third fan (in parallel) was added to correct flow variability. Design adequacy of the fans is demonstrated by operational history and passing routine functional tests. Regular visual inspections of the fans and motors in accordance with current maintenance procedures and schedules ensure proper and consistent function. The operating fans and motors are inspected for operational variables such as abnormal noise, excessive vibration, and fan bearing temperatures, and are lubricated as needed.

Adequacy of the HEPA filters and housings has been demonstrated by operational history and successful testing in accordance with guidance provided in ASME/ANSI N510. The existing system has been successfully tested annually in its current configuration since 1995.

- ASME/ANSI N510:

As allowed in ASME/ANSI N510, certain sections of N510 may be used as technical guidance for non-N509 systems. To demonstrate the adequacy of the system design and operation, both stages of HEPA filters are aerosol tested individually in-place annually (at a minimum control efficiency of 99.95 percent) to meet the intent of ANSI N510. This annual testing includes a visual inspection of the housing as described in ANSI N510.

- ANSI/ASME NQA-1:

NQA-1 sections addressing abatement technology components design were not applicable during system construction and so are not addressed. Quality assurance for sampling of emissions and subsequent analysis is addressed in HNF-0528-3, *NESHAP Quality Assurance Project Plan for Radioactive Airborne Emissions* (all of Sections 2.0, 3.0 and 5.0), which was written in accordance with applicable NQA-1 requirements.

- 40 CFR 60, Appendix A

Stack flow is tested using Methods 1 and 2. Methods 1A, 2A, 2C, and 2D are not applicable to the stack dimensions/design. Relative humidity (as allowed in Method 2) is measured with a calibrated hygrometer or with wet and dry bulb readings. Methods 4, 5, and 17, which provide a method for measuring relative humidity for combustion sources, are not applicable to radioactive airborne effluent stacks.

- ANSI N13.1:

The sampling system appears to comply with ANSI N13.1 (1969) criteria. The stack probe, a rake design with 10 nozzles, was installed in the mid-1980's. The nozzles do measure equal annular area as described in the standard. The probe location is a minimum of five stack diameters downstream from abrupt changes in flow direction. Sample tubing and number of bends are minimized as much as physically practical. The probe was designed to provide near isokinetic sampling at a given stack flow. The stack will be operated to maintain near isokinetic sampling. Currently the sample system is operated to provide periodic confirmatory measurements only, as described in Section 9.0.

Adequacy of the sampling system is demonstrated by inspection, calibration, and maintenance activities as scheduled in current facility procedures.

19.0 REFERENCES

AIR 92-107, Letter, WDOH to DOE-RL, "Surveillance Report Generated by the DOH of KE & KW Basin on 09/16/1992"", October 05, 1992

AIR 99-507, Letter, WDOH to DOE-RL, "Technical Justification for Temporary Deviation to American Society of Mechanical Engineers (ASME) AG-1, Section FC 5100 High Efficiency Particulate Air (HEPA) Filter Qualification Test Requirements", May 19, 1999.

ANSI N13.1, *Guide to Sampling Airborne Radioactive Materials in a Nuclear Facility*, 1969, American National Standards Institute, New York, New York.

ANSI/ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*, 1994, American National Standards Institute and American Society of Mechanical Engineers, New York, New York.

ASME/ANSI AG-1, *Code on Nuclear Air and Gas Treatment*, 1991, American Society of Mechanical Engineers and American National Standards Institute, New York, New York.

ASME/ANSI-N509, *Nuclear Power Plant Air-Cleaning Units and Components*, 1989, American Society of Mechanical Engineers and American National Standards Institute, New York, New York.

ASME/ANSI N510, *Testing of Nuclear Air Treatment Systems*, 1989, American Society of Mechanical Engineers and American National Standards Institute, New York, New York.

HNF-SD-SNF-TI-061, Rev. 1, *Shippingport Pressurized Water Reactor Core 2 Blanket Assemblies Source Term Calculations Using ORIGEN2*, July 1999, Fluor Hanford, Richland, Washington

HNF-0528-3, *NESHAP Quality Assurance Project Plan for Radioactive Air Emissions*, September 1998, Fluor Hanford, Richland, Washington.

HNF-3553, Annex A, Rev. 0-A, Addendum A, *Spent Nuclear Fuel Project Canister Storage Building Final Safety Analysis Report*, May 2000, Fluor Hanford, Richland, Washington.

HNF-6456, Rev.0, *Solid Waste Treatment Facility Fuel Removal Project Execution Plan*, September 2000, Fluor Hanford, Richland, Washington.

PNNL 2000a, E-mail: L. H. Staven (PNNL) to R. E. Johnson (FH), *200w factors*, May 16, 2000.

PNNL 2000b, E-mail: L. H. Staven (PNNL) to R. E. Johnson (FH), *200w synopsis files for 10 and 40 m release heights*, May 25, 2000.

WAPD-335, "Shippingport Operations During PWR Core 2 Depletion (April 1965 to February 1974)", Appendix B, "Crud Examination After PWR Core 2 Seed 1 Operation", June 1983, Bettis Atomic Power Laboratory, West Mifflin, Pennsylvania

WAPD-LP[CES]CS-105, Letter, D. T. Howard, Betttis Atomic Power Laboratory, to D. J. Cockeram, Rockwell Hanford Operations, "Arrangements for PWR-2 Spent Fuel Shipments using the M-160 Shipping Container", November 15, 1977

WAPD-MT[CRCT]-45, Internal Memo, Bettis Atomic Power Laboratory, E. F. Benz to F. L. Lau, "Crud Activity Estimate for PWR Core", August 11, 1977

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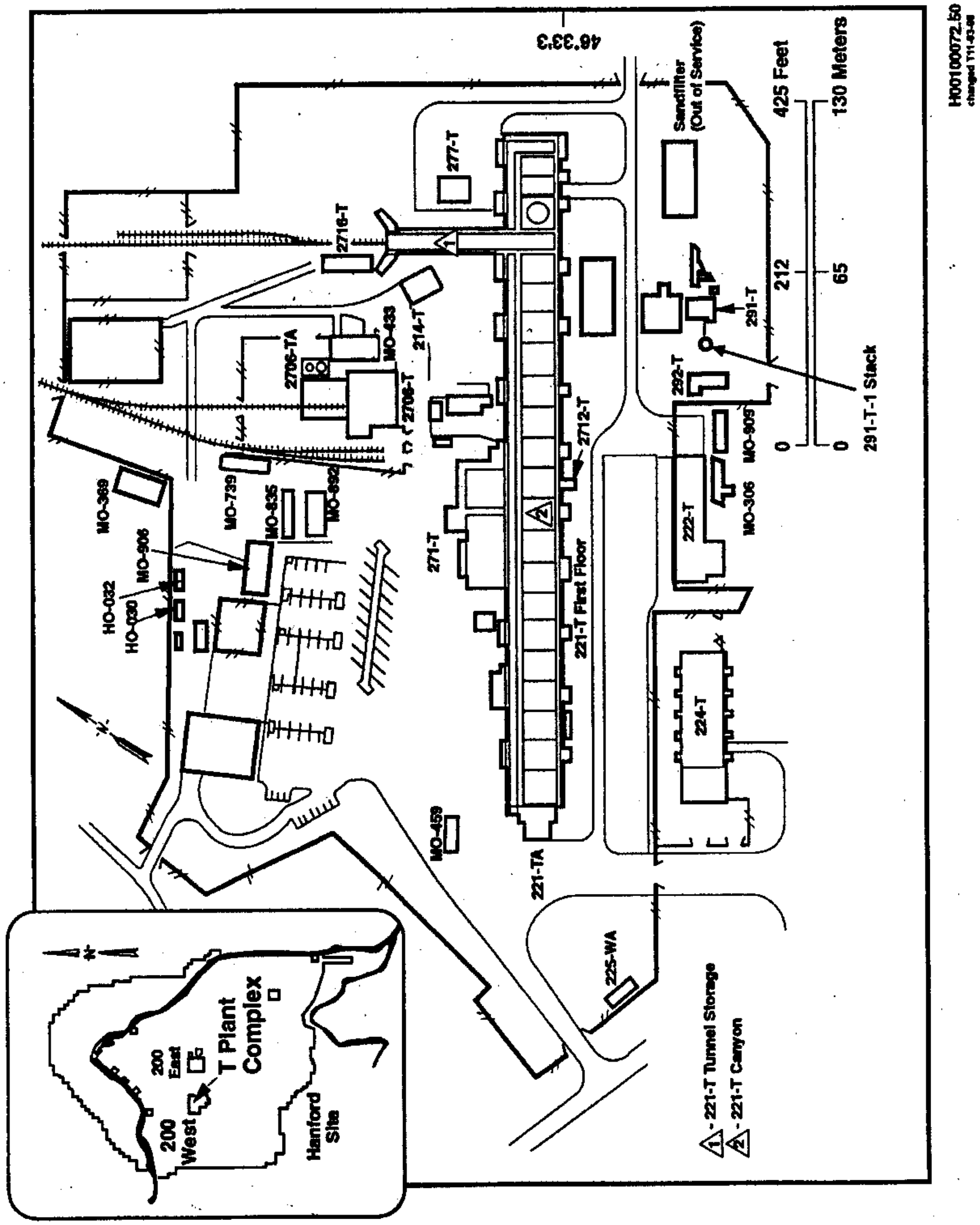


Figure 1. Location of T Plant Complex and the 291-T-1 Stack in the 200 West Area.

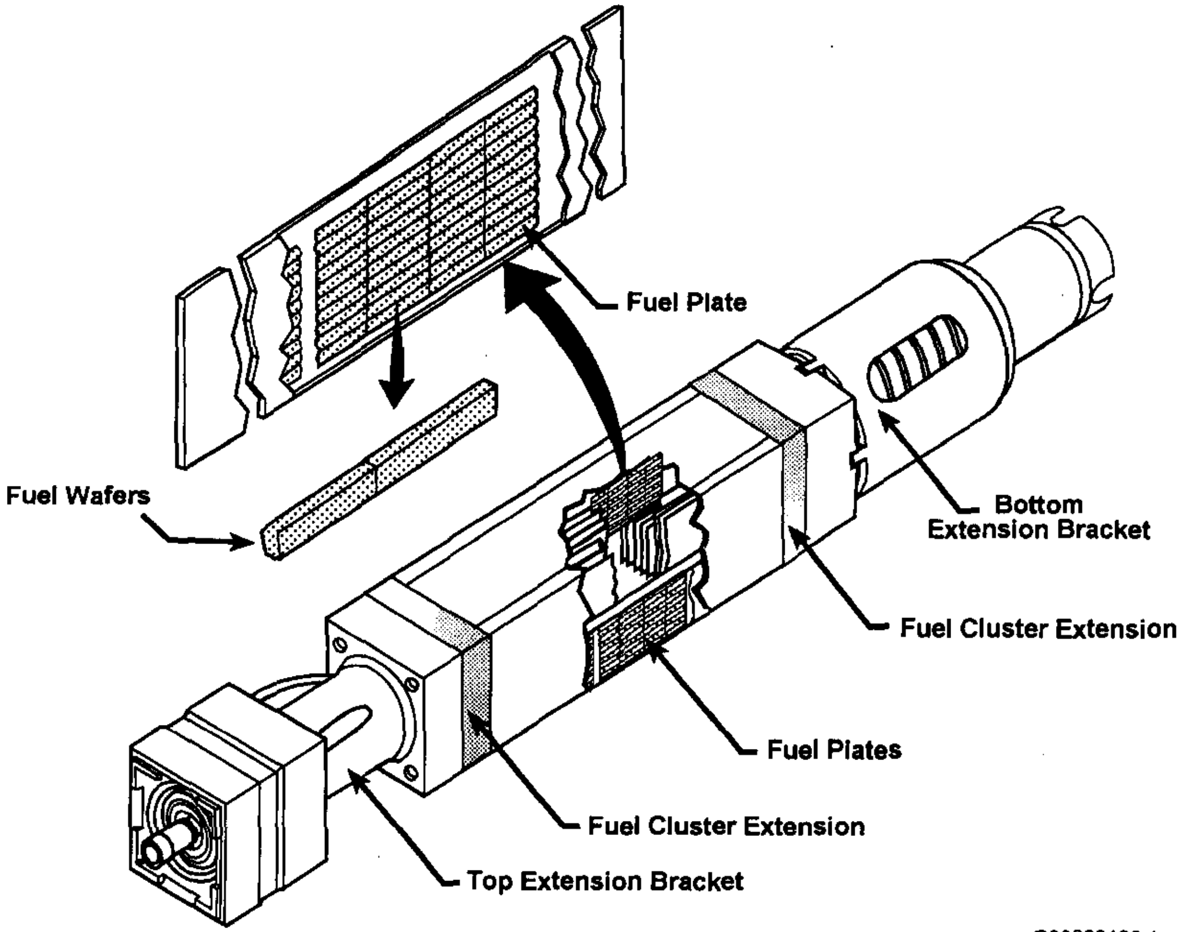
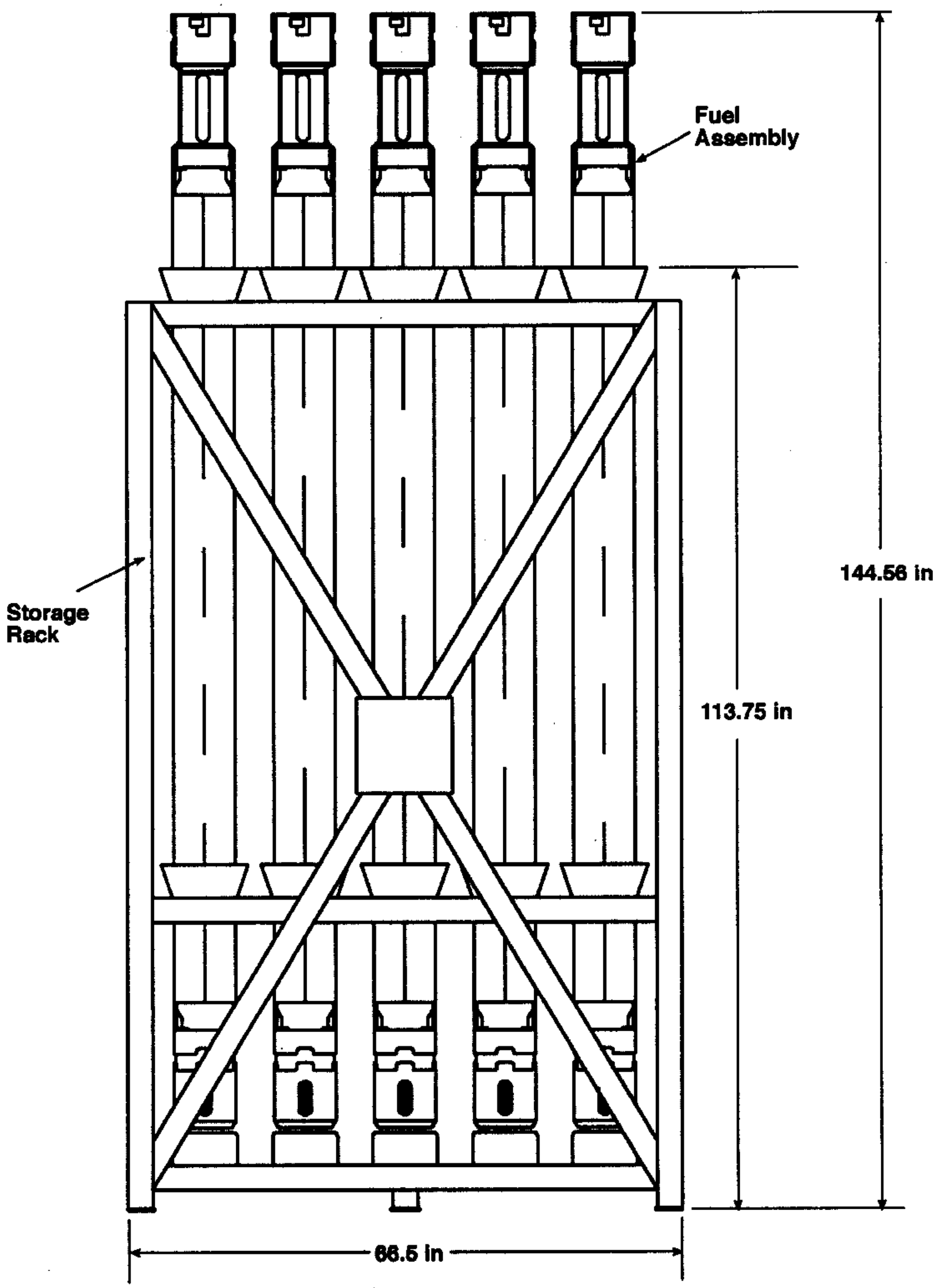


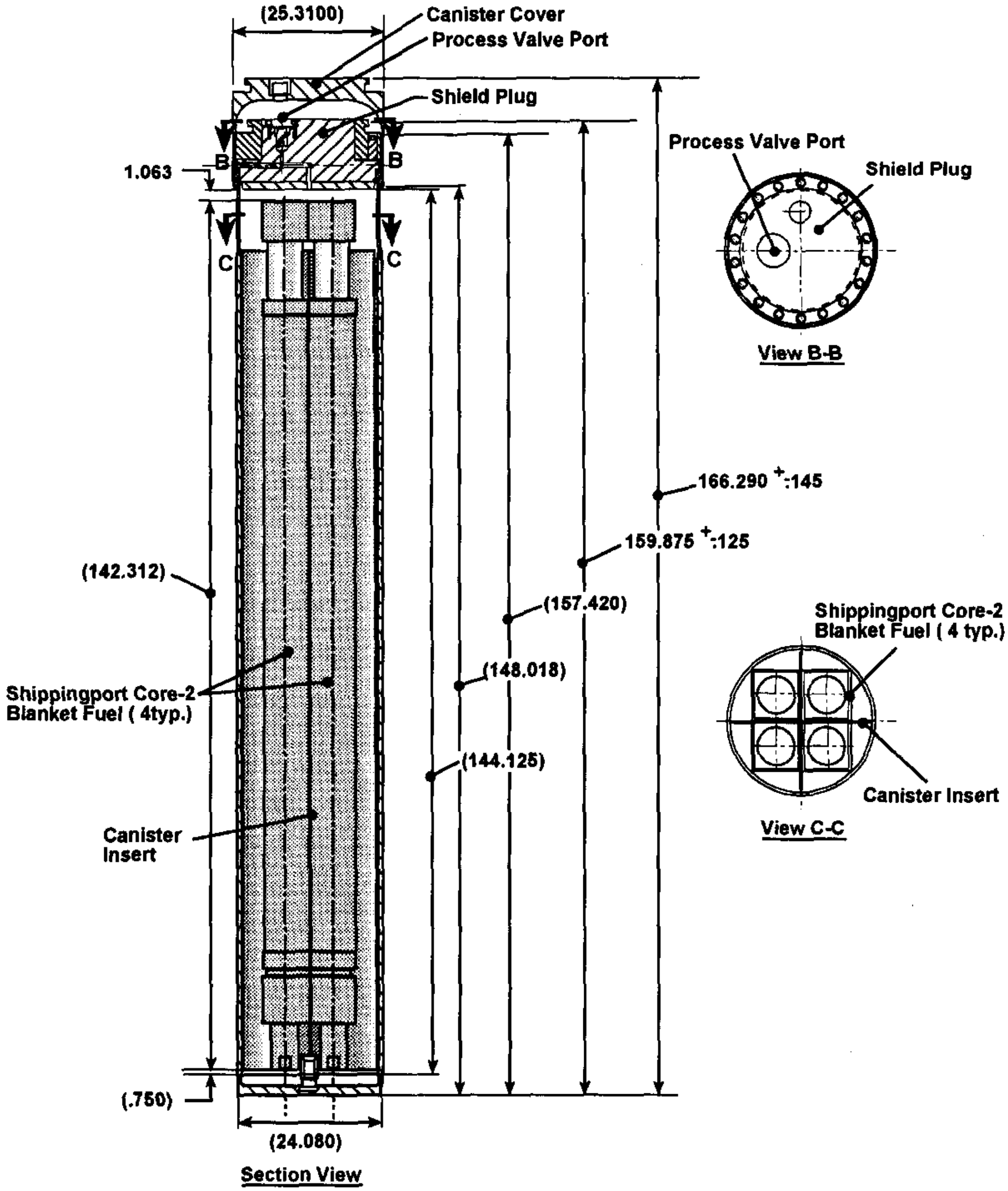
Figure 2. PWR Core 2 Blanket Fuel Assembly.



Source: HNF-6456

H00080137.2

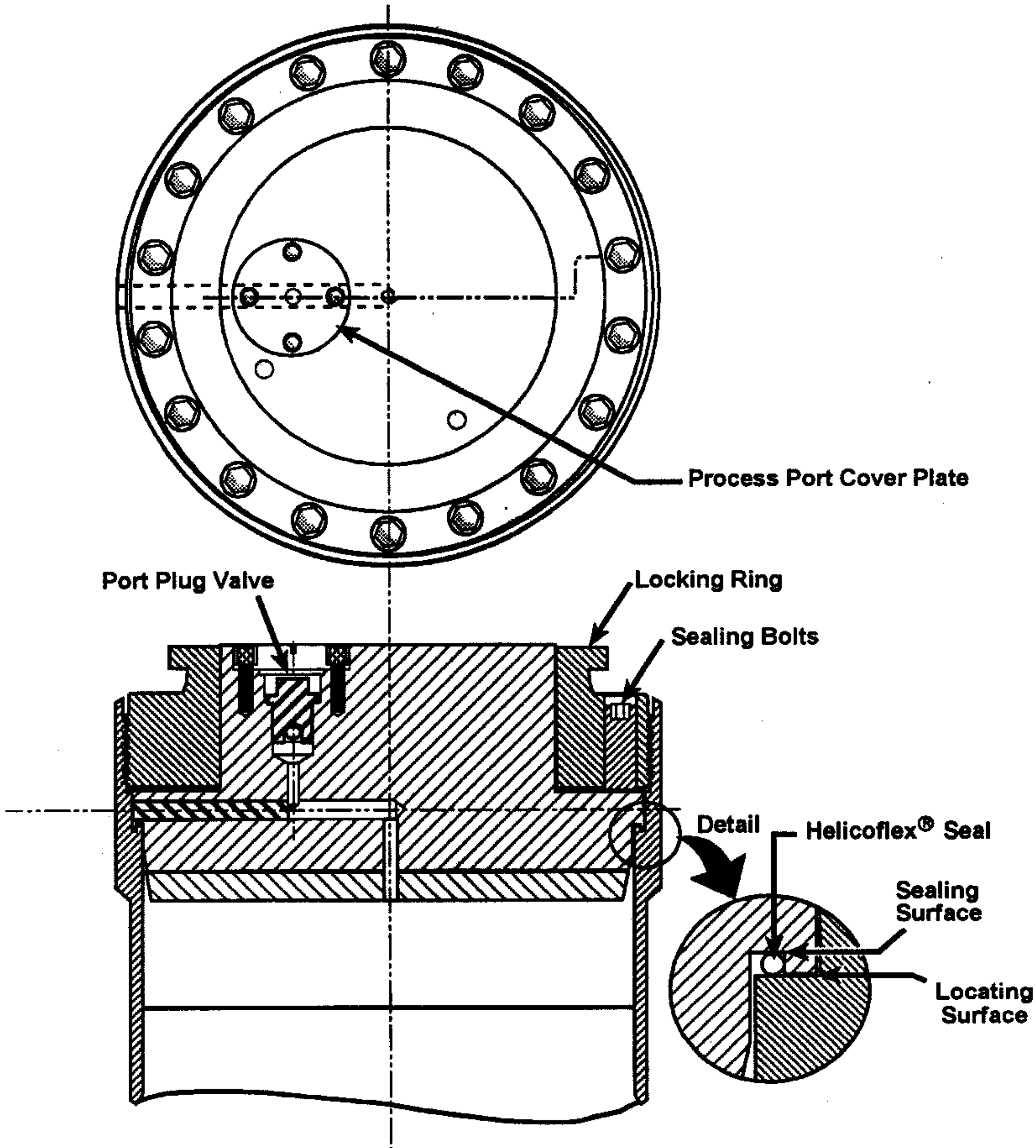
Figure 3. Fuel Assemblies in the Storage Racks.



Source: HNF-3553 Rev. 0-A

G00090100.3R1

Figure 4. Shippingport Spent Fuel Canister.



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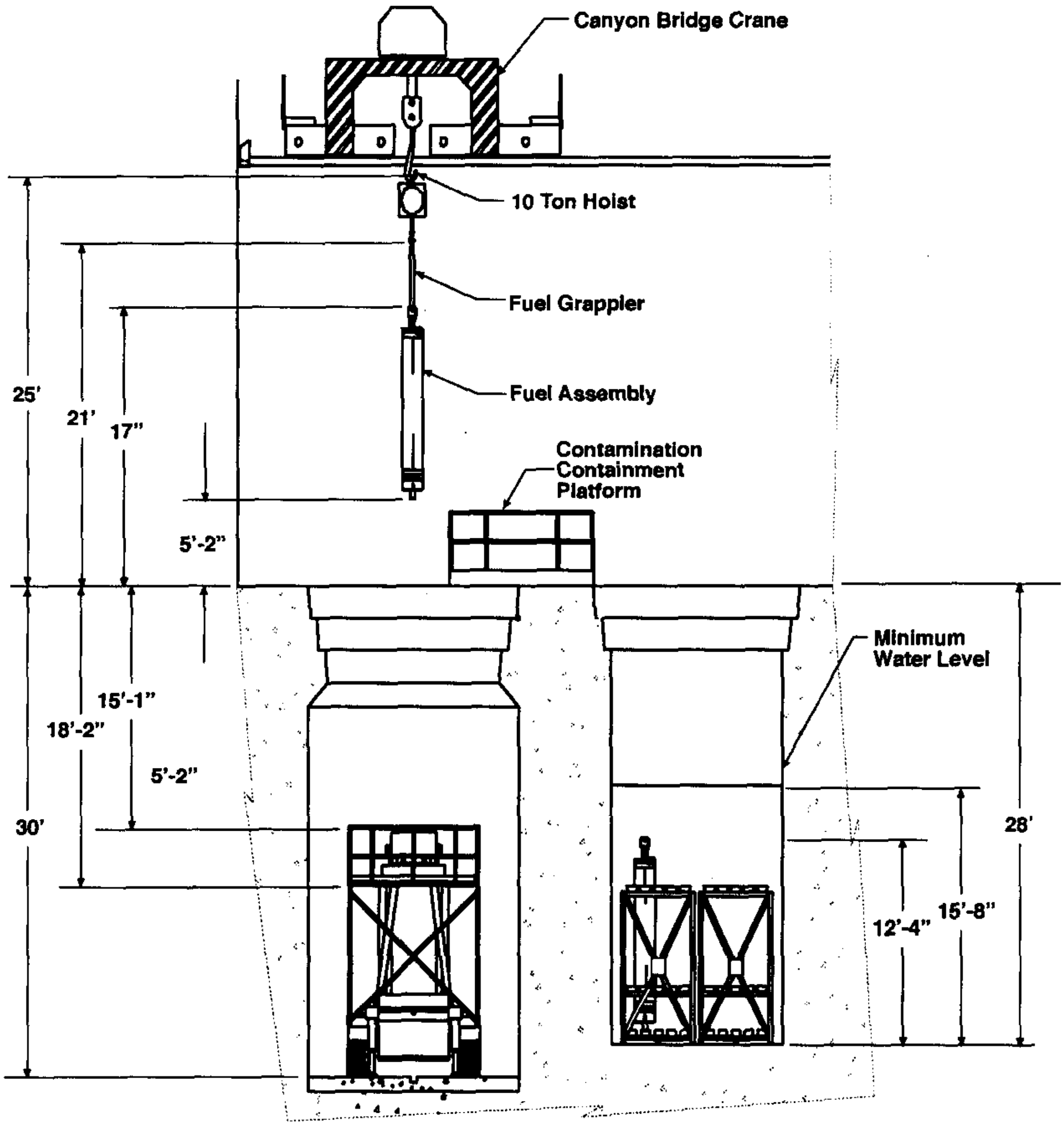
G00090100.2R1

Figure 5. Shippingport Spent Fuel Canister Shield Plug.



Source: HNF-6456

Figure 6. Vertical Cross-Section of Fuel Pool Cell and Tunnel.

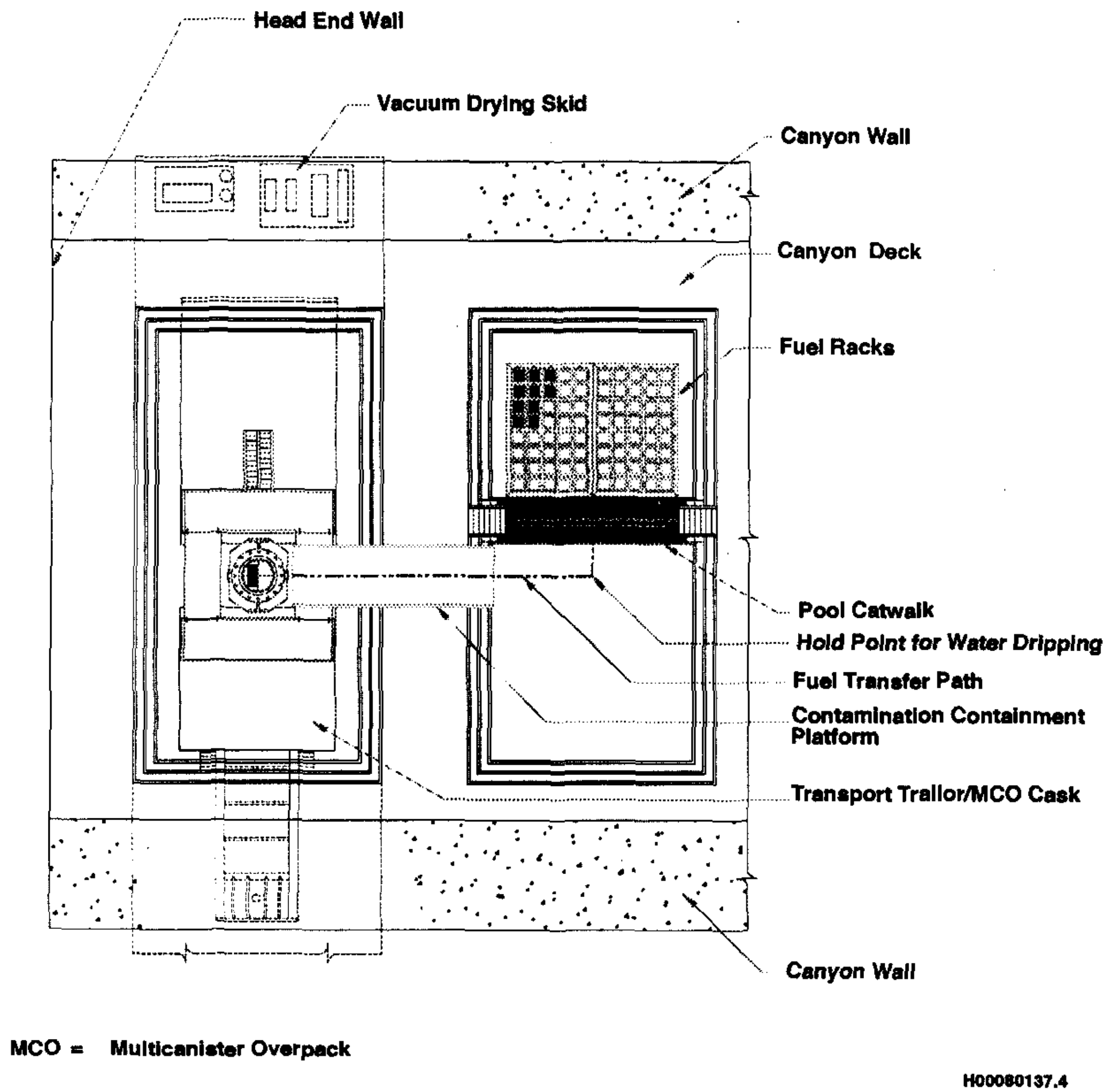


Figure 7. Horizontal Cross-Section of Fuel Pool Cell and Tunnel.

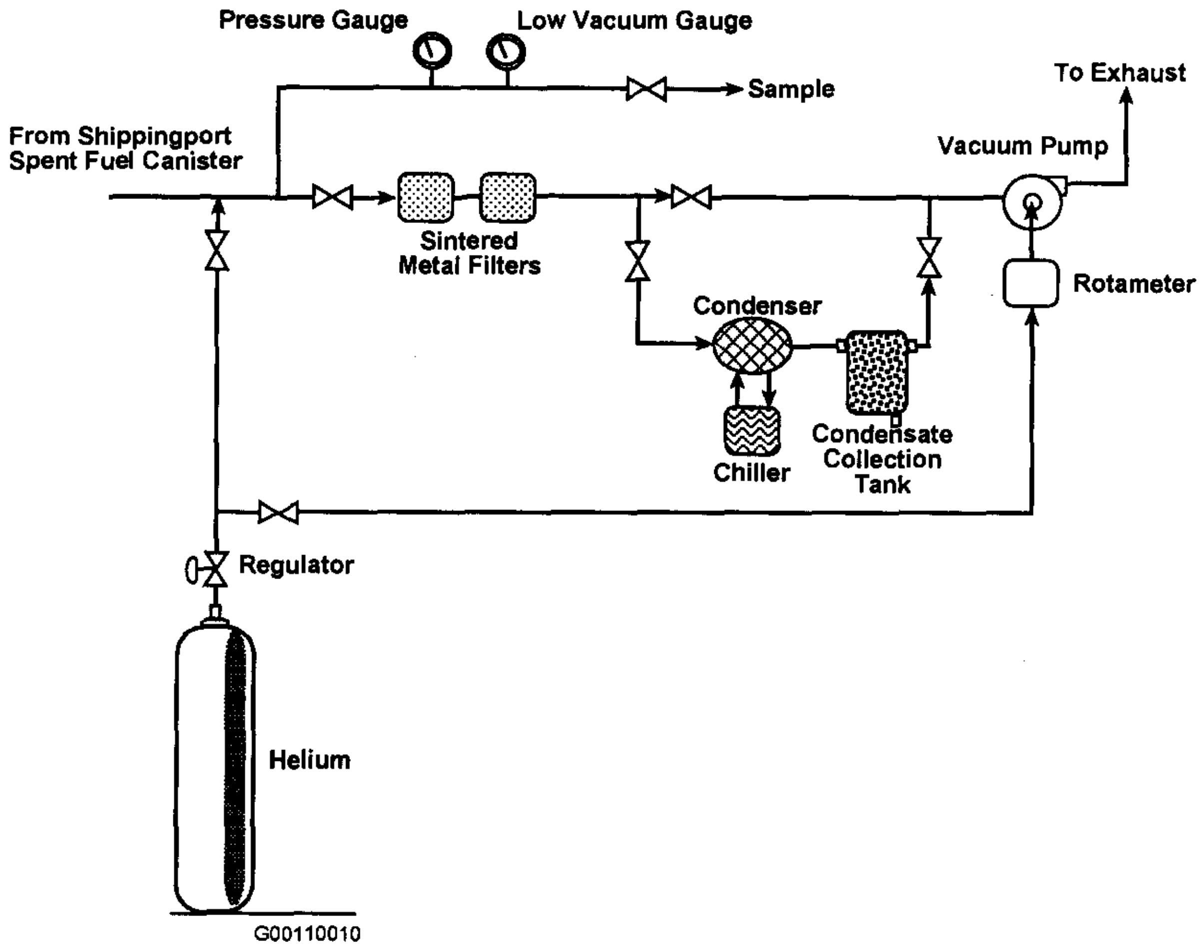


Figure 8. Fuel Conditioning Skid.

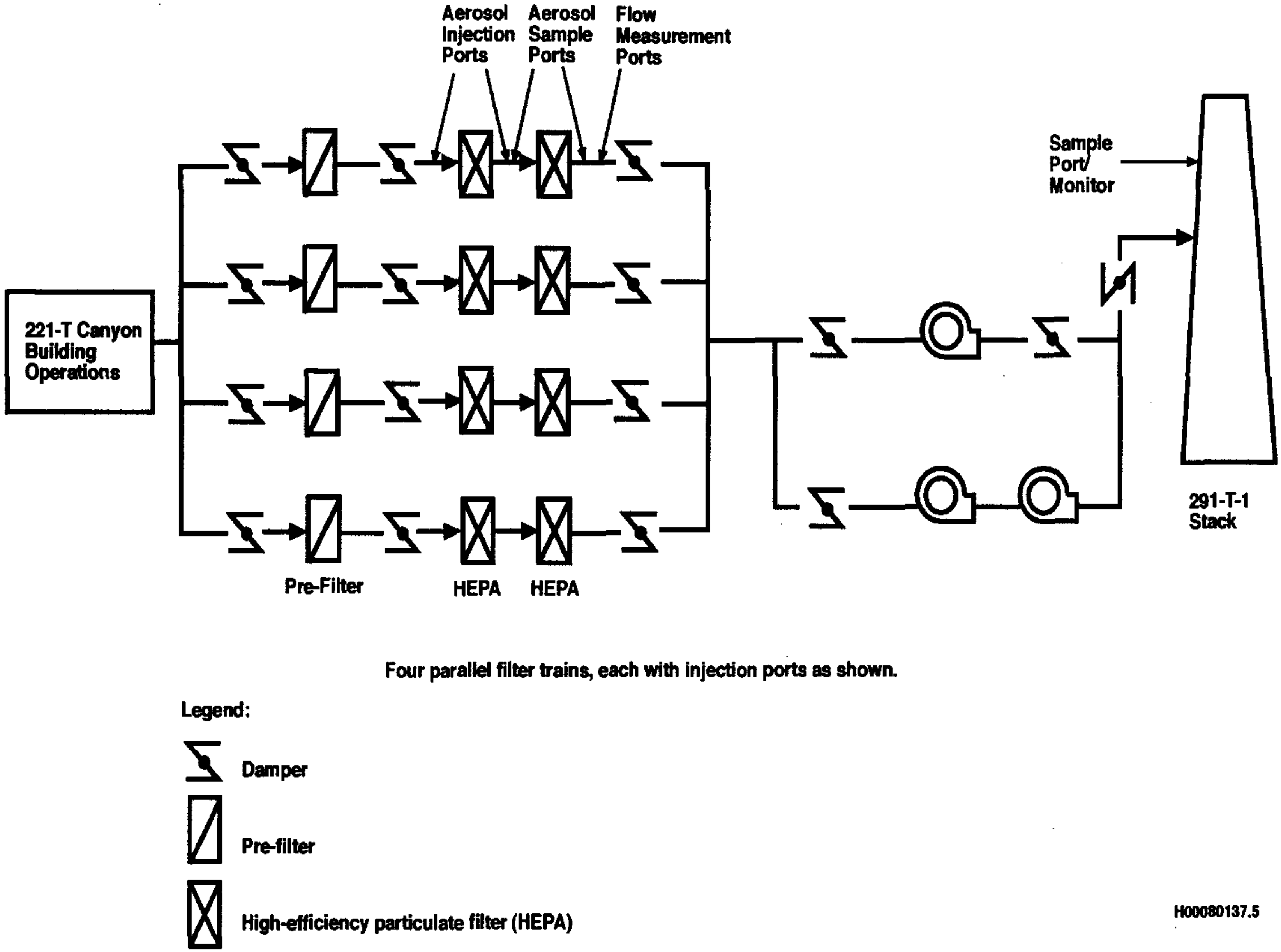


Figure 9. Ventilation Flow Diagram for the 291-T-1 Stack.

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Table 1. T Plant Complex Fuel Removal Project Inventory

Radionuclides	Physical Form	Inventory (Ci)	Release Factor	Potential Release (Ci)
Crud Activity (decayed to 2001)				
Fe-55	particulate	2.1 E-3	1.0 E-3	2.1 E-6
Co-60	particulate	3.9 E-2	1.0 E-3	3.9 E-5
Ni-63	particulate	1.6 E-2	1.0 E-3	1.6 E-5
Sr-90	particulate	4.6 E-4	1.0 E-3	4.6 E-7
Pu-238	particulate	5.7 E-4	1.0 E-3	5.7 E-7
Spent Fuel Pool Water Activity				
C0-60	liquid	1.2 E-2	1.0 E-3	1.2 E-5
Cs-137	liquid	4.4 E-4	1.0 E-3	4.4 E-7

Table 2. T Plant Complex Fuel Removal Project Potential-to-Emit.

Radionuclides	Potential Unabated Release (Ci/yr)	Potential Abated Release (Ci/yr)	Dose Factor CAP88-PC* (mrem/Ci)	Unabated Offsite Dose (mrem/yr)	Abated Offsite Dose (mrem/yr)
Fe-55	2.1 E-6	1.1 E-09	4.79 E-5	1.0 E-10	5.3 E-14
Co-60	5.1 E-5	2.6 E-08	2.33 E-1	1.2 E-05	6.1 E-09
Ni-63	1.6 E-5	8.0 E-09	5.30 E-5	8.5 E-10	4.2 E-13
Sr-90	4.6 E-7	2.3 E-10	8.71 E-3	4.0 E-09	2.0 E-12
Cs-137	4.4 E-7	2.2 E-10	2.09 E-3	9.2 E-10	4.6 E-13
Pu-238	5.7 E-7	2.9 E-10	6.53 E+0	3.7 E-06	1.9 E-09
Total				1.6 E-5	8.0 E-09

* Attachment 1

Table 3. Status of Conformance to Technology Standards.

STANDARD	REQUIREMENT	STATUS
ANSI/ASME AG-1	Fans	Not applicable (built before standard implemented)
	Ductwork	Not applicable (built before standard implemented)
	HEPAS filters	Applicable to replacement HEPA filters, conforms as described in Section 18.0
	Dampers	Not applicable (built before standard implemented)
	Quality assurance	Not applicable (built before standard implemented)
ASME/ANSI N509	Heater	Heater meets functional intent of N509
	Filter housing	Pre-filters, two stages of HEPA filters (in four parallel banks), and dampers are certified to meet purchase order specifications regarding fabrication, materials, welds and final inspections
ASME/ANSI N510	Pressure decay test	Completed at installation (passed test); conforms to requirement
	Visual inspection	Performed annually (with no significant findings identified); conforms to requirement
	Aerosol test	Performed annually; meets intent of N510 requirements as described in Section 18.0
ANSI/ASME NQA-1	Design requirements	Not applicable (built before standard implemented)
	Sampling and analysis procedures	Complies with HNF-0528-3; conforms to applicable NQA-1 requirements
40 CFR 60, Appendix A	Methods 1 and 2	Applicable (annual testing conforms to requirements)
	Methods 1A, 2A, 2C, 2D, 4, 5, and 17	Not applicable
ANSI 13.1 (1969)	Equal annular nozzle spacing	conforms to requirements
	Near isokinetic sampling and other requirements	Not fully assessed but appears compliant; sampling system provides periodic confirmatory measurements as described in Sections 9.0 and 18.0

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ATTACHMENT 1

CALCULATION OF DOSE FROM 200 WEST AREA TO ONSITE MEMBER OF THE PUBLIC

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Calculation of Dose from 200 W Area to Onsite Member of the Public

L. H. Staven
May 9, 2000

Pacific Northwest National Laboratory
Richland, Washington

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Introduction

Dose estimates for unit Ci releases of selected radionuclides were calculated for emissions from the 200 West Area of the Hanford Site. These estimates will be used as generic dose conversion factors to determine emission monitoring requirements for the 200 West facilities.

Methods for Calculating Radiation Dose

The desktop computer version of the Clean Air Act Compliance code (CAP88-PC, Parks 1992) was used to calculate the effective dose equivalent (EDE) to the receptors from routine chronic 10 and 40 m releases from 200 West Area.

Release and Atmospheric Transport Assumptions

Redox was selected as the most conservative facility to model 200 West Area emissions because it is the closest to the receptors. One Ci of each selected radionuclide was assumed to leave the facility at 10 and 40 m heights with no plume rise.

The 200 West meteorological data were used to model the direction and probability of dispersion. Data were collected at the 10 m height for calendar years 1983 through 1996 in 200 West Area.

Locations around Hanford boundaries, and selected onsite non-DOE facilities were modeled to determine the locations with the highest chi/Q, or the probability to have the greatest integrated air concentration over the course of a year. Those sites with the highest chi/Q were selected to represent the location of the receptors.

Exposure and Dose Assumptions

The dose from the non-ingestion pathways (i.e., inhalation and external) is proportional to the amount of time a receptor spends at the point of exposure. The reported doses for the onsite receptors conservatively assume that the individual is on site the entire year, for the full 8766 h/y.

The onsite public worker was assumed to consume food grown regionally, that is, where the population is located in a 50 mile radius of the 200 Areas. The ingestion dose is added to the inhalation and external doses.

Hanford specific parameters were used as documented in PNL-3777 (Schreckhise et al., 1990). The default file used for Hanford calculations is shown in Appendix A.

Calculation Results

Doses were calculated for on onsite member of the public working at LIGO, and are shown in Table ATT-1-1. The location of the LIGO facility relative to 200 West Area is 18310 m to the east by southeast.

References

Parks, B. S. 1992. User's Guide for CAP88-PC. Version 1.0. 402-B-92-001. Office of Radiation Programs, U.S. Environmental Protection Agency, Las Vegas, Nevada.

Schreckhise, R. G., K. Rhoads, J. S. Davis, B. A. Napier, and J. V. Ramsdell. 1993. Recommended Environmental Dose Calculation Methods and Hanford-Specific Parameters. PNL-3777, Rev. 2. Pacific Northwest Laboratory, Richland Washington.

Appendix A

A.1 Hanford Default Average Individual file for CAP88PC

```
FILE:  DEFAULTP.HAN  Hanford Average Ind. Parameters  Revised 3/29/00 KR

&METE TG = .0728, .1090, .1455 &END
&USAG BRTHRT = 9.7E+05, DD1 = 1.0, UF = 79.0, UL = 15.0, UM = 230.0,
    UV = 140.0 &END
&POOL DILFAC = 1.0, USEFAC = 0.01 &END
&AGDT FSUBG = 0.25,   FSUBL = 0.25,   FSUBP = 0.75,   FSUBS = 1.0,
    LAMW = 3.0E-03,  MSUBB = 200.0,  P = 224.0,       QSUBF = 15.6,
    R1 = 0.25,       R2 = 0.25,      TAUBEF = .00381, TSUBE1 = 720.0,
    TSUBE2 = 2160.0, TSUBF = 2.0,    TSUBH1 = 0.0,    TSUBH2 = 2400.0,
    TSUBH3 = 336.0,  TSUBH4 = 336.0, TSUBS = 34.0,    VSUBM = 11.0,
    YSUBV1 = 0.3,    YSUBV2 = 2.0,   TSUBB = 50.0     &END
&INPUT ILOC = 0, JLOC = 0, PLOC = 100.0, GSCFAC = 0.5 &END
&ORGAN NR_ORGNS = 8, ORGN = 'GONADS  ', 'BREAST  ', 'R MAR   ', 'LUNGS   ',
                 'THYROID ', 'ENDOST  ', 'RMNDR   ', 'EFFEC   ',
    NR_ORG_WTS =  7, PATH =  5,  5,  5,  5,  5,  5,  5,
    ORG_WTS = 0.25, 0.15, 0.12, 0.12, 0.03, 0.03, 0.30 &END
&CANCER NR_CANCERS = 11, CANC =  'LEUKEMIA', 'BONE    ', 'THYROID ',
             'BREAST  ', 'LUNG    ', 'STOMACH ', 'BOWEL   ',
             'LIVER   ', 'PANCREAS', 'URINARY ', 'OTHER   ',
     &END
&GENTIC NR_GENETICS = 3, GEN_ORGNS = 'TESTES  ', 'OVARIES ', 'AVERAGE ',
     REPPER = 0.014113 &END
&LOCTBLP NTLOC = 4,
      RNLOC =  'WLSUM   ', 'WLSUM   ', 'SUM     ', 'SUM     ',
      OGLOC =  'SUM     ', 'SUM     ', 'SUM     ','SUM     ',
      PTLOC =  7,  7,  7,  7,
      FALOC =  2,  2,  1,  1,
      LTABLE =  1,  3,  1,  3, &END
&LOCTBLI NTLOC = 2,
      RNLOC = 'WLSUM   ', 'SUM     ',
      OGLOC = 'SUM     ', 'SUM     ',
      PTLOC =  7,  7,
      FALOC =  2,  1,
      LTABLE =  1,  1,  &END
```

NOTE: The NAMELISTS need to be in the order they are read by the program. If a NAMELIST is not needed it will simply be ignored. The system reads sequentially until it finds a match.

A.2 Hanford Default maximum individual file for CAP88PC

```
FILE:  DEFAULTM.HAN  Hanford Parameters  Revised 6/5/97 KR

&METE TG = .0728, .1090, .1455 &END
&USAG BRTHRT = 9.7E+05, DD1 = 1.0, UF = 98.0, UL = 30.0, UM = 270.0,
    UV = 220.0 &END
&POOL DILFAC = 1.0, USEFAC = 0.01 &END
&AGDT FSUBG = 1.0,    FSUBL = 1.0,    FSUBP = 0.75,    FSUBS = 1.0,
    LAMW = 3.0E-03,  MSUBB = 200.0,  P = 224.0,     QSUBF = 15.6,
    R1 = 0.25,      R2 = 0.25,     TAUBEF = .00381, TSUBE1 = 720.0,
    TSUBE2 = 2160.0, TSUBF = 2.0,    TSUBH1 = 0.0,    TSUBH2 = 2400.0,
    TSUBH3 = 24.0,   TSUBH4 = 120.0, TSUBS = 15.0,    VSUBM = 11.0,
    YSUBV1 = 0.3,    YSUBV2 = 2.0,   TSUBB = 50.0     &END
&INPUT ILOC = 0, JLOC = 0, PLOC = 100.0, GSCFAC = 1.0 &END
&ORGAN NR_ORGNS = 8, ORGN = 'GONADS  ', 'BREAST  ', 'R MAR   ', 'LUNGS   ',
                 'THYROID ', 'ENDOST  ', 'RMNDR   ', 'EFFEC   ',
     NR_ORG_WTS =  7, PATH =  5,  5,  5,  5,  5,  5,  5,
     ORG_WTS = 0.25, 0.15, 0.12, 0.12, 0.03, 0.03, 0.30 &END
&CANCER NR_CANCERS = 11, CANC =   'LEUKEMIA', 'BONE    ', 'THYROID ',
              'BREAST  ', 'LUNG    ', 'STOMACH ', 'BOWEL   ',
              'LIVER   ', 'PANCREAS', 'URINARY ', 'OTHER   ',
      &END
&GENTIC NR_GENETICS = 3, GEN_ORGNS = 'TESTES  ', 'OVARIES ', 'AVERAGE ',
      REPPER = 0.014113 &END
&LOCTBLP NTLOC = 4,
      RNLOC =  'WLSUM   ', 'WLSUM   ', 'SUM     ', 'SUM     ',
      OGLOC =  'SUM     ', 'SUM     ', 'SUM     ','SUM     ',
      PTLOC =  7,  7,  7,  7,
      FALOC =  2,  2,  1,  1,
      LTABLE =  1,  3,  1,  3, &END
&LOCTBLI NTLOC = 2,
      RNLOC =  'WLSUM   ', 'SUM     ',
      OGLOC =  'SUM     ', 'SUM     ',
      PTLOC =  7,  7,
      FALOC =  2,  1,
      LTABLE =  1,  1,  &END
```

NOTE: The NAMELISTS need to be in the order they are read by the program. If a NAMELIST is not needed it will simply be ignored. The system reads sequentially until it finds a match.

1

Table ATT-1-1. 200 West Area -- LIGO Worker (a) CAP88-PC Unit Dose Factors by Effective Release Height (40 m) with Regional Ingestion

CHI/q 8.982 E-08 s/m^3 18310 m ESE

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
H-3	3.23E-06	2.42E-06	5.65E-06	4.28E-01
BE-7	1.72E-04	2.93E-07	1.72E-04	1.70E-03
BE-10 (b)	(Sr-90)	(Sr-90)	(Sr-90)	
C-11	5.41E-07	0.00E+00	5.41E-07	0.00E+00
C-14	2.96E-07	1.69E-04	1.69E-04	9.98E-01
C-15 (c)	0.00E+00	0.00E+00	0.00E+00	
N-13	6.69E-08	0.00E+00	6.69E-08	0.00E+00
O-15	6.37E-14	0.00E+00	6.37E-14	0.00E+00
F-18	7.06E-06	0.00E+00	7.06E-06	0.00E+00
NA-22	1.12E-01	1.04E-03	1.13E-01	9.18E-03
NA-24	1.90E-04	3.46E-07	1.90E-04	1.82E-03
P-32	1.24E-04	1.28E-04	2.52E-04	5.08E-01
S-35	6.10E-06	2.52E-05	3.13E-05	8.05E-01
AR-41	7.16E-06	0.00E+00	7.16E-06	0.00E+00
K-40	6.62E-02	2.82E-03	6.90E-02	4.08E-02
CA-41	9.98E-06	0.00E+00	9.98E-06	0.00E+00
SC-46	1.04E-02	4.52E-05	1.04E-02	4.33E-03
CR-51	6.35E-05	5.32E-07	6.40E-05	8.31E-03
MN-54	1.56E-02	1.06E-05	1.56E-02	6.81E-04
MN-56	2.13E-05	0.00E+00	2.13E-05	0.00E+00
FE-55	3.98E-05	8.11E-06	4.79E-05	1.69E-01
FE-59	3.21E-03	4.34E-05	3.25E-03	1.33E-02
CO-57	2.42E-03	1.68E-05	2.44E-03	6.88E-03
CO-58	4.41E-03	3.54E-05	4.45E-03	7.96E-03
CO-60	2.33E-01	4.26E-04	2.33E-01	1.82E-03
NI-59	2.20E-04	2.31E-06	2.22E-04	1.04E-02
NI-63	4.69E-05	6.06E-06	5.30E-05	1.14E-01
NI-65	8.38E-06	0.00E+00	8.38E-06	0.00E+00
CU-64	1.35E-05	2.66E-09	1.35E-05	1.97E-04
ZN-65	8.34E-03	1.07E-03	9.41E-03	1.13E-01
ZN-69	2.78E-07	0.00E+00	2.78E-07	0.00E+00
ZN-69M	3.56E-05	5.85E-08	3.57E-05	1.64E-03
GA-67	4.46E-05	2.66E-08	4.46E-05	5.96E-04
AS-76	1.17E-04	2.66E-08	1.17E-04	2.27E-04
SE-79 (b)	(Pu-241)	(Pu-241)	(Pu-241)	
BR-82	2.72E-04	2.07E-06	2.74E-04	7.57E-03
BR-83	6.30E-08	0.00E+00	6.30E-08	0.00E+00
BR-84	2.41E-06	0.00E+00	2.41E-06	0.00E+00
BR-85	6.45E-13	0.00E+00	6.45E-13	0.00E+00
KR-83M	1.29E-09	0.00E+00	1.29E-09	0.00E+00

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
KR-85	4.78E-08	0.00E+00	4.78E-08	0.00E+00
KR-85M	1.48E-06	0.00E+00	1.48E-06	0.00E+00
KR-87	3.49E-06	0.00E+00	3.49E-06	0.00E+00
KR-88	1.66E-05	0.00E+00	1.66E-05	0.00E+00
KR-89	6.83E-11	0.00E+00	6.83E-11	0.00E+00
KR-90 (c)	4.20E-37	0.00E+00	4.20E-37	
RB-86	2.71E-04	1.17E-04	3.88E-04	3.01E-01
RB-87	1.52E-04	5.25E-04	6.77E-04	7.75E-01
RB-88	3.27E-07	0.00E+00	3.27E-07	0.00E+00
RB-89	5.98E-07	0.00E+00	5.98E-07	0.00E+00
RB-90	7.36E-12	0.00E+00	7.36E-12	0.00E+00
RB-90M	2.09E-09	0.00E+00	2.09E-09	0.00E+00
SR-89	1.34E-04	3.63E-05	1.70E-04	2.13E-01
SR-90	4.56E-03	4.15E-03	8.71E-03	4.77E-01
SR-91	3.83E-05	2.66E-09	3.83E-05	6.94E-05
SR-92	1.94E-05	0.00E+00	1.94E-05	0.00E+00
Y-90	1.87E-04	2.13E-07	1.87E-04	1.14E-03
Y-90M	7.16E-06	0.00E+00	7.16E-06	0.00E+00
Y-91	1.02E-03	2.13E-05	1.04E-03	2.04E-02
Y-91M	1.44E-06	0.00E+00	1.44E-06	0.00E+00
Y-92	1.77E-05	0.00E+00	1.77E-05	0.00E+00
Y-93	5.03E-05	0.00E+00	5.03E-05	0.00E+00
ZR-93	9.86E-04	6.38E-06	9.92E-04	6.43E-03
ZR-95	3.17E-03	1.41E-05	3.18E-03	4.43E-03
NB-93M	8.24E-04	9.28E-05	9.17E-04	1.01E-01
NB-94	7.75E-01	1.60E-03	7.77E-01	2.05E-03
NB-95	1.77E-03	1.69E-04	1.94E-03	8.74E-02
NB-95M	6.49E-05	1.10E-05	7.59E-05	1.45E-01
NB-97	3.46E-06	0.00E+00	3.46E-06	0.00E+00
NB-97M	7.48E-22	0.00E+00	7.48E-22	0.00E+00
MO-93	2.76E-03	0.00E+00	2.76E-03	0.00E+00
MO-99	*1.15E-04*	*7.98E-07*	*1.16E-04*	*6.89E-03*
MO-99 +D	1.42E-04	7.98E-07	1.43E-04	5.60E-03
TC-97	3.08E-03	1.80E-04	3.26E-03	5.53E-02
TC-99	1.73E-04	1.54E-03	1.71E-03	8.99E-01
TC-101	6.93E-08	0.00E+00	6.93E-08	0.00E+00
RU-97	5.41E-05	2.66E-08	5.41E-05	4.91E-04
RU-103	1.37E-03	6.65E-06	1.38E-03	4.83E-03
RU-105	2.06E-05	0.00E+00	2.06E-05	0.00E+00
RU-106	9.81E-03	1.01E-04	9.91E-03	1.02E-02
RH-105	2.91E-05	8.88E-07	3.00E-05	2.96E-02
RH-105M	2.27E-28	0.00E+00	2.27E-28	0.00E+00
RH-106 (c)	0.00E+00	0.00E+00	0.00E+00	
PD-107	2.61E-04	5.40E-06	2.66E-04	2.03E-02
PD-109	2.90E-05	1.06E-07	2.91E-05	3.65E-03
AG-109M	4.61E-33	0.00E+00	4.61E-33	0.00E+00
AG-110 (c)	0.00E+00	0.00E+00	0.00E+00	

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
AG-110M	4.13E-02	3.75E-04	4.17E-02	9.00E-03
AG-111	1.46E-04	4.96E-05	1.96E-04	2.53E-01
CD-113 (b)	(Pu-241)	(Pu-241)	(Pu-241)	
CD-113M (b)	(Pu-241)	(Pu-241)	(Pu-241)	
CD-115	1.22E-04	7.45E-07	1.23E-04	6.07E-03
CD-115M	9.53E-04	5.13E-05	1.00E-03	5.11E-02
IN-113M	1.88E-06	0.00E+00	1.88E-06	0.00E+00
IN-115	2.11E-02	1.17E-03	2.23E-02	5.27E-02
IN-115M	4.78E-06	0.00E+00	4.78E-06	0.00E+00
SN-113	3.34E-04	1.06E-04	4.40E-04	2.42E-01
SN-123	5.05E-05	0.00E+00	5.05E-05	0.00E+00
SN-125	5.01E-04	3.24E-05	5.33E-04	6.08E-02
SN-126	3.08E-02	1.03E-03	3.18E-02	3.23E-02
SB-124	6.92E-03	2.39E-05	6.94E-03	3.45E-03
SB-125	2.51E-02	1.06E-05	2.51E-02	4.24E-04
SB-126	2.38E-03	8.51E-06	2.39E-03	3.56E-03
SB-126M	7.21E-07	0.00E+00	7.21E-07	0.00E+00
SB-127	2.91E-04	5.85E-07	2.92E-04	2.01E-03
TE-125M	2.25E-04	2.35E-05	2.49E-04	9.47E-02
TE-127	7.24E-06	0.00E+00	7.24E-06	0.00E+00
TE-127M	4.89E-04	6.81E-05	5.57E-04	1.22E-01
TE-129	9.14E-07	0.00E+00	9.14E-07	0.00E+00
TE-129M	5.68E-04	4.71E-05	6.15E-04	7.65E-02
TE-131	4.80E-07	0.00E+00	4.80E-07	0.00E+00
TE-131M	2.07E-04	5.32E-08	2.07E-04	2.57E-04
TE-132	2.11E-04	7.18E-07	2.12E-04	3.39E-03
TE-133	1.30E-07	0.00E+00	1.30E-07	0.00E+00
TE-133M	6.48E-06	0.00E+00	6.48E-06	0.00E+00
TE-134	1.66E-06	0.00E+00	1.66E-06	0.00E+00
I-122	1.57E-11	0.00E+00	1.57E-11	0.00E+00
I-123	9.89E-06	1.25E-08	9.90E-06	1.26E-03
I-125	2.09E-04	3.15E-04	5.24E-04	6.01E-01
I-129	1.91E-02	5.70E-03	2.48E-02	2.30E-01
I-130	1.10E-04	9.04E-08	1.10E-04	8.21E-04
I-131	4.18E-04	1.54E-04	5.72E-04	2.70E-01
I-132	1.24E-05	0.00E+00	1.24E-05	0.00E+00
I-133	6.46E-05	1.04E-06	6.56E-05	1.59E-02
I-134	2.59E-06	0.00E+00	2.59E-06	0.00E+00
I-135	3.56E-05	0.00E+00	3.56E-05	0.00E+00
XE-122	8.68E-07	0.00E+00	8.68E-07	0.00E+00
XE-123	3.86E-06	0.00E+00	3.86E-06	0.00E+00
XE-125	3.13E-06	0.00E+00	3.13E-06	0.00E+00
XE-127	3.71E-06	0.00E+00	3.71E-06	0.00E+00
XE-131M	1.35E-07	0.00E+00	1.35E-07	0.00E+00
XE-133	4.90E-07	0.00E+00	4.90E-07	0.00E+00
XE-133M	4.18E-07	0.00E+00	4.18E-07	0.00E+00
XE-135	2.82E-06	0.00E+00	2.82E-06	0.00E+00

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
XE-135M	1.19E-07	0.00E+00	1.19E-07	0.00E+00
XE-137	4.59E-11	0.00E+00	4.59E-11	0.00E+00
XE-138	2.77E-07	0.00E+00	2.77E-07	0.00E+00
CS-134	6.85E-02	1.68E-03	7.02E-02	2.39E-02
CS-134M	7.37E-07	0.00E+00	7.37E-07	0.00E+00
CS-135	9.60E-05	2.42E-04	3.38E-04	7.16E-01
CS-136	1.87E-03	6.76E-05	1.94E-03	3.49E-02
CS-137	*6.36E-04*	*1.45E-03*	*2.09E-03*	*6.95E-01*
CS-137 +D	2.10E-01	1.45E-03	2.11E-01	6.87E-03
CS-138	3.33E-06	0.00E+00	3.33E-06	0.00E+00
CS-139	1.69E-08	0.00E+00	1.69E-08	0.00E+00
BA-133	7.27E-02	0.00E+00	7.27E-02	0.00E+00
BA-133M	1.96E-05	5.32E-08	1.97E-05	2.71E-03
BA-137M	1.24E-12	0.00E+00	1.24E-12	0.00E+00
BA-139	1.37E-06	0.00E+00	1.37E-06	0.00E+00
BA-140	*2.40E-04*	*9.47E-06*	*2.49E-04*	*3.80E-02*
BA-140 +D	1.88E-03	9.47E-06	1.89E-03	5.01E-03
BA-141	3.55E-07	0.00E+00	3.55E-07	0.00E+00
BA-142	7.67E-08	0.00E+00	7.67E-08	0.00E+00
LA-140	3.39E-04	0.00E+00	3.39E-04	0.00E+00
LA-141	5.57E-07	0.00E+00	5.57E-07	0.00E+00
LA-142	1.62E-05	0.00E+00	1.62E-05	0.00E+00
CE-141	3.57E-04	5.05E-06	3.62E-04	1.40E-02
CE-143	9.66E-05	2.66E-08	9.66E-05	2.75E-04
CE-144	8.05E-03	6.38E-05	8.11E-03	7.87E-03
PR-143	1.74E-04	3.99E-06	1.78E-04	2.24E-02
PR-144	5.68E-08	0.00E+00	5.68E-08	0.00E+00
PR-144M	1.01E-09	0.00E+00	1.01E-09	0.00E+00
ND-147	2.40E-04	2.85E-06	2.43E-04	1.17E-02
PM-147	7.95E-04	5.85E-06	8.01E-04	7.31E-03
PM-148	4.15E-04	1.86E-06	4.17E-04	4.47E-03
PM-148M	6.11E-03	2.93E-05	6.14E-03	4.77E-03
PM-149	6.68E-05	5.32E-08	6.69E-05	7.96E-04
PM-151	2.73E-05	0.00E+00	2.73E-05	0.00E+00
SM-147	1.53E+00	1.06E-03	1.53E+00	6.95E-04
SM-151	6.18E-04	2.39E-06	6.20E-04	3.86E-03
SM-153	5.19E-05	2.66E-08	5.19E-05	5.12E-04
EU-152	2.35E-01	2.66E-05	2.35E-01	1.13E-04
EU-152M	9.04E-06	0.00E+00	9.04E-06	0.00E+00
EU-154	1.90E-01	5.32E-05	1.90E-01	2.80E-04
EU-155	7.42E-03	1.06E-05	7.43E-03	1.43E-03
EU-156	1.46E-03	1.12E-05	1.47E-03	7.59E-03
GD-152 (b)	(Pu-239)	(Pu-239)	(Pu-239)	
TB-160	5.08E-03	2.39E-05	5.10E-03	4.69E-03
HO-166	7.22E-05	0.00E+00	7.22E-05	0.00E+00
HO-166M	7.76E-01	0.00E+00	7.76E-01	0.00E+00
HF-181	1.72E-03	9.84E-06	1.73E-03	5.69E-03

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
W-181	3.27E-04	5.80E-06	3.33E-04	1.74E-02
W-185	1.59E-05	2.66E-05	4.25E-05	6.26E-01
W-187	4.48E-05	2.66E-08	4.48E-05	5.93E-04
RE-187	1.13E-06	6.95E-07	1.82E-06	3.81E-01
IR-192	4.42E-03	1.49E-05	4.43E-03	3.36E-03
HG-203	8.14E-04	1.42E-04	9.56E-04	1.49E-01
TL-207	2.09E-11	0.00E+00	2.09E-11	0.00E+00
TL-208	7.77E-11	0.00E+00	7.77E-11	0.00E+00
TL-209	4.94E-13	0.00E+00	4.94E-13	0.00E+00
PB-209	1.17E-06	0.00E+00	1.17E-06	0.00E+00
PB-210	*2.86E-01*	*2.02E-02*	*3.06E-01*	*6.60E-02*
PB-210 +D	2.86E-01	2.02E-02	3.06E-01	6.61E-02
PB-211	2.20E-05	0.00E+00	2.20E-05	0.00E+00
PB-212	2.89E-03	0.00E+00	2.89E-03	0.00E+00
PB-214	1.54E-06	0.00E+00	1.54E-06	0.00E+00
BI-210	3.96E-03	0.00E+00	3.96E-03	0.00E+00
BI-211	2.53E-13	0.00E+00	2.53E-13	0.00E+00
BI-212	1.54E-04	0.00E+00	1.54E-04	0.00E+00
BI-213	4.28E-06	0.00E+00	4.28E-06	0.00E+00
BI-214	1.08E-06	0.00E+00	1.08E-06	0.00E+00
PO-210	1.79E-01	5.80E-03	1.85E-01	3.14E-02
PO-212 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-213 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-214 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-215 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-216 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-218	1.78E-12	0.00E+00	1.78E-12	0.00E+00
AT-217 (c)	0.00E+00	0.00E+00	0.00E+00	
RN-219 (e)	5.15E-04	3.64E-05	5.51E-04	6.61E-02
RN-220 (e)	4.05E-06	0.00E+00	4.05E-06	0.00E+00
RN-222	5.95E-05	0.00E+00	5.95E-05	0.00E+00
FR-221	1.00E-08	0.00E+00	1.00E-08	0.00E+00
FR-223	2.57E-06	0.00E+00	2.57E-06	0.00E+00
RA-223	1.70E-01	6.91E-04	1.71E-01	4.05E-03
RA-224	7.09E-02	5.32E-05	7.10E-02	7.50E-04
RA-225	8.59E-02	7.45E-04	8.66E-02	8.59E-03
RA-226	1.85E-01	5.11E-03	1.90E-01	2.69E-02
RA-228	5.00E-02	2.61E-03	5.26E-02	4.95E-02
AC-225	1.25E-01	5.32E-05	1.25E-01	4.25E-04
AC-227	1.31E+01	1.06E-02	1.31E+01	8.11E-04
AC-228	1.31E-03	0.00E+00	1.31E-03	0.00E+00
TH-227	2.41E-01	2.66E-05	2.41E-01	1.10E-04
TH-228	5.19E+00	0.00E+00	5.19E+00	0.00E+00
TH-229	1.44E+01	2.66E-03	1.44E+01	1.85E-04
TH-230	5.13E+00	2.66E-03	5.13E+00	5.18E-04
TH-231	1.98E-05	0.00E+00	1.98E-05	0.00E+00
TH-232	*7.39E+00*	*0.00E+00*	*7.39E+00*	*0.00E+00*

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
TH-232 +D	8.62E+00	1.09E-04	8.62E+00	1.26E-05
TH-234	7.47E-04	1.89E-05	7.66E-04	2.47E-02
PA-231	9.89E+00	1.60E-02	9.91E+00	1.61E-03
PA-233	5.75E-04	5.32E-06	5.80E-04	9.17E-03
PA-234	5.93E-05	0.00E+00	5.93E-05	0.00E+00
PA-234M	3.02E-21	0.00E+00	3.02E-21	0.00E+00
U-232	9.87E+00	1.06E-02	9.88E+00	1.08E-03
U-233	2.75E+00	2.66E-03	2.75E+00	9.66E-04
U-234	2.71E+00	5.32E-03	2.72E+00	1.96E-03
U-235	2.59E+00	4.26E-03	2.59E+00	1.64E-03
U-236	2.57E+00	4.26E-03	2.57E+00	1.65E-03
U-237	1.41E-04	1.65E-06	1.43E-04	1.16E-02
U-238	2.41E+00	3.99E-03	2.41E+00	1.65E-03
U-240	4.46E-05	0.00E+00	4.46E-05	0.00E+00
NP-237	1.01E+01	1.33E-02	1.01E+01	1.31E-03
NP-238	7.07E-04	0.00E+00	7.07E-04	0.00E+00
NP-239	8.13E-05	2.66E-08	8.13E-05	3.27E-04
NP-240	4.74E-06	0.00E+00	4.74E-06	0.00E+00
NP-240M	6.64E-09	0.00E+00	6.64E-09	0.00E+00
PU-236	1.81E+00	1.33E-03	1.81E+00	7.34E-04
PU-238	6.52E+00	1.33E-02	6.53E+00	2.04E-03
PU-239	7.01E+00	1.06E-02	7.02E+00	1.52E-03
PU-240	7.01E+00	1.33E-02	7.02E+00	1.89E-03
PU-241	1.07E-01	2.39E-04	1.07E-01	2.23E-03
PU-242	6.67E+00	1.06E-02	6.68E+00	1.59E-03
PU-243	3.63E-06	0.00E+00	3.63E-06	0.00E+00
PU-244	6.62E+00	1.33E-02	6.63E+00	2.00E-03
AM-241	1.12E+01	1.33E-02	1.12E+01	1.19E-03
AM-242	1.09E-03	0.00E+00	1.09E-03	0.00E+00
AM-242M	1.07E+01	1.33E-02	1.07E+01	1.24E-03
AM-243	1.12E+01	1.33E-02	1.12E+01	1.19E-03
CM-242	3.68E-01	2.66E-04	3.68E-01	7.22E-04
CM-243	7.50E+00	7.98E-03	7.51E+00	1.06E-03
CM-244	5.89E+00	7.98E-03	5.90E+00	1.35E-03
CM-245	1.15E+01	1.33E-02	1.15E+01	1.16E-03
CM-246	1.14E+01	1.33E-02	1.14E+01	1.17E-03
CM-247	1.06E+01	1.33E-02	1.06E+01	1.25E-03
CM-248	4.19E+01	5.32E-02	4.20E+01	1.27E-03
CF-252	3.18E+00	2.66E-03	3.18E+00	8.36E-04

(a) Doses to workers conservatively assume that the worker is onsite 24 hours a day.
(b) Dose factors not included in the CAP88PC library. Suggest using DCF from radionuclide in parentheses.
(c) Very short-lived radionuclide. Dose is zero for onsite Public worker.
(d) "+D" desigantion indicateds that the doses from grow-in progeny are included in the reported dose.
(e) Short-lived Rn isotopes were modeled based on the dose from their long-lived progeny. For each Ci of Rn-219 released, 0.0018 Ci of Pb-210 is generated. Each Ci of Rn-220 produces 0.0014 Ci of Pb-212. Dose is based on the Pb progeny times the appropriate equilibrium factor.

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ATTACHMENT 2

CAP88-PC SYNOPSIS REPORT (1 OF 10)

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CAP88-PC

Version 1.00

Clean Air Act Assessment Package - 1988

SYNOPSIS REPORT

Non-Radon Individual Assessment
May 9, 2000 10:36 am

Facility: 200W REDOX 40m eff DATASET1
Address: BATTELLE PNL
POB 999
City: RICHLAND
State: WA Zip: 99352

Effective Dose Equivalent
(mrem/year)

4.56E-01

At This Location: 18310 Meters East Southeast

Source Category: 40.0 M STACK UNIT CI AIRBORNE RELEASE
Source Type: Stack
Emission Year:

Comments: worker set 1 (of 10) use defaultp.han

Dataset Name: w 2w 40m set1
Dataset Date: May 9, 2000 10:26 am
Wind File: WNDFILES\HS200W10.WND

C A U T I O N: Defaults Have Been Changed

(Changes Detailed on Next Page)

CAUTION!

The Following DEFAULT VALUES Have Been Changed By The User.

These changes CANNOT BE USED to demonstrate compliance per 40 CFR 61.93(a) unless specifically approved by EPA.

Inhalation Rate of Man

Changed From: 9.1670E+05
To: 9.7000E+05

Fraction Radioactivity on Veg. & Prod. after Washing

Changed From: 0.5000
To: 1.000

Ingestion Rate of Meat by Man

Changed From: 85.00
To: 98.00

Ingestion Rate of Leafy Veg. by Man

Changed From: 18.00
To: 30.00

Ingestion Rate of Milk by Man

Changed From: 112.0
To: 270.0

Ingestion Rate of Produce by Man

Changed From: 176.0
To: 220.0

Fraction Time Spent Swimming

Changed From: 0.0000
To: 1.0000E-02

Fraction Year Animals Graze on Pasture

Changed From: 0.4000
To: 0.7500

Fraction Year Animals Graze on Pasture

Changed From: 0.4300
To: 1.0000

The Following DEFAULT VALUES Have Been Changed By The User (Continued):

Removal Rate Constant - Physical Loss by Weathering

Changed From: 2.9000E-03
To: 3.0000E-03

Effec. Surface Density of Soil, Dry Weight

Changed From: 215.0
To: 224.0

Fallout interception Fraction-Pasture

Changed From: 0.5700
To: 0.2500

Fallout Interception Fraction-Vegetable

Changed From: 0.2000
To: 0.2500

Period Exposure - Growing Season - Crops/Leafy Veg.

Changed From: 1440.
To: 2160.

Time Delay - Ingestion Stored Feed

Changed From: 2160.
To: 2400.

Time Delay - Ingestion Leafy Veg. - Man

Changed From: 336.0.
To: 24.00

Time Delay - Ingestion Produce - Man

Changed From: 336.0.
To: 120.0

Avg. Time - Slaughter to Consumption

Changed From: 20.00
To: 34.00

The Following DEFAULT VALUES Have Been Changed By The User (Continued):

Agr. Productivity by Unit Area - Milk

Changed From: 0.2800
To: 0.3000

Agr. Productivity by Unit Area - Prod/Leafy Veg.

Changed From: 0.7160
To: 2.000

Period Long-term Buildup in Soil

Changed From: 100.0
To: 50.00

Direction Single Location - Individual Calculation

Changed From: 0
To: 12

Direction Single Location - Individual Calculation

Changed From: 0
To: 1

Ground Surface Correction Factor
Changed From: 0.5000
To: 1.000

May 9, 2000 10:36 am SYNOPSIS

Page 1
(w 2w 40m set1)

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 18310 Meters East Southeast
Lifetime Fatal Cancer Risk: 1.12E-05

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Dose Equivalent (mrem/y))
GONADS	5.28E-01
BREAST	4.80E-01
R MAR	4.07E-01
LUNGS	4.37E-01
THYROID	5.01E-01
ENDOST	4.36E-01
RMNDR	4.09E-01
EFFEC	4.56E-01

May 9, 2000 10:36 am SYNOPSIS
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(w 2w 40m set1)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
H-3	*	0.00	1.0E+00	1.0E+00
BE-7	Y	1.00	1.0E+00	1.0E+00
BE-10		0.00	1.0E+00	1.0E+00
C-11	D	1.00	1.0E+00	1.0E+00
C-14	*	0.00	1.0E+00	1.0E+00
C-15	D	1.00	1.0E+00	1.0E+00
N-13	D	1.00	1.0E+00	1.0E+00
O-15	D	1.00	1.0E+00	1.0E+00
F-18	D	1.00	1.0E+00	1.0E+00
NA-22	D	1.00	1.0E+00	1.0E+00
NA-24	D	1.00	1.0E+00	1.0E+00
P-32	D	1.00	1.0E+00	1.0E+00
S-35	D	1.00	1.0E+00	1.0E+00
AR-41	*	0.00	1.0E+00	1.0E+00
K-40	D	1.00	1.0E+00	1.0E+00
CA-41		0.00	1.0E+00	1.0E+00
SC-46	Y	1.00	1.0E+00	1.0E+00
CR-51	Y	1.00	1.0E+00	1.0E+00
MN-54	W	1.00	1.0E+00	1.0E+00
MN-56	W	1.00	1.0E+00	1.0E+00
FE-55	W	1.00	1.0E+00	1.0E+00
FE-59	W	1.00	1.0E+00	1.0E+00
CO-57	Y	1.00	1.0E+00	1.0E+00
CO-58	Y	1.00	1.0E+00	1.0E+00
CO-60	Y	1.00	1.0E+00	1.0E+00
NI-59	W	1.00	1.0E+00	1.0E+00
NI-63	W	1.00	1.0E+00	1.0E+00
NI-65	W	1.00	1.0E+00	1.0E+00
CU-64	Y	1.00	1.0E+00	1.0E+00
ZN-65	Y	1.00	1.0E+00	1.0E+00
ZN-69	Y	1.00	1.0E+00	1.0E+00
ZN-69M	Y	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

May 9, 2000 10:36 am SYNOPSIS
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(w 2w 40m set2)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
GA-67	W	1.00	1.0E+00	1.0E+00
AS-76	W	1.00	1.0E+00	1.0E+00
SE-79		0.00	1.0E+00	1.0E+00
BR-82	D	1.00	1.0E+00	1.0E+00
BR-83		0.00	1.0E+00	1.0E+00
BR-84		0.00	1.0E+00	1.0E+00
BR-85		0.00	1.0E+00	1.0E+00
KR-83M	*	0.00	1.0E+00	1.0E+00
KR-85	*	0.00	1.0E+00	1.0E+00
KR-87	*	0.00	1.0E+00	1.0E+00
KR-88	*	0.00	1.0E+00	1.0E+00
KR-89	*	0.00	1.0E+00	1.0E+00
Kr-90	*	0.00	1.0E+00	1.0E+00
RB-86	D	1.00	1.0E+00	1.0E+00
RB-87	D	1.00	1.0E+00	1.0E+00
RB-88	D	1.00	1.0E+00	1.0E+00
RB-89	D	1.00	1.0E+00	1.0E+00
RB-90		0.00	1.0E+00	1.0E+00
RB-90M		0.00	1.0E+00	1.0E+00
SR-89	D	1.00	1.0E+00	1.0E+00
SR-90	D	1.00	1.0E+00	1.0E+00
SR-91	D	1.00	1.0E+00	1.0E+00
SR-92	D	1.00	1.0E+00	1.0E+00
Y-90	Y	1.00	1.0E+00	1.0E+00
Y-90M		0.00	1.0E+00	1.0E+00
Y-91	Y	1.00	1.0E+00	1.0E+00
Y-91M	Y	1.00	1.0E+00	1.0E+00
Y-92	Y	1.00	1.0E+00	1.0E+00
Y-93	Y	1.00	1.0E+00	1.0E+00
ZR-93	W	1.00	1.0E+00	1.0E+00
ZR-95	W	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
NB-93M	Y	1.00	1.0E+00	1.0E+00
NB-94	Y	1.00	1.0E+00	1.0E+00
NB-95	Y	1.00	1.0E+00	1.0E+00
NB-95M	Y	1.00	1.0E+00	1.0E+00
NB-97	Y	1.00	1.0E+00	1.0E+00
NB-97M	Y	1.00	1.0E+00	1.0E+00
MO-93		0.00	1.0E+00	1.0E+00
MO-99	Y	1.00	1.0E+00	1.0E+00
TC-99M	W	1.00	1.0E+00	1.0E+00
TC-97	W	1.00	1.0E+00	1.0E+00
TC-99	W	1.00	1.0E+00	1.0E+00
TC-101		0.00	1.0E+00	1.0E+00
RU-97	Y	1.00	1.0E+00	1.0E+00
RU-103	Y	1.00	1.0E+00	1.0E+00
RU-105	Y	1.00	1.0E+00	1.0E+00
RU-106	Y	1.00	1.0E+00	1.0E+00
RH-105	Y	1.00	1.0E+00	1.0E+00
RH-105M	Y	1.00	1.0E+00	1.0E+00
RH-106	Y	1.00	1.0E+00	1.0E+00
PD-107	Y	1.00	1.0E+00	1.0E+00
PD-109	Y	1.00	1.0E+00	1.0E+00
AG-109M	Y	1.00	1.0E+00	1.0E+00
AG-110	Y	1.00	1.0E+00	1.0E+00
AG-110M	Y	1.00	1.0E+00	1.0E+00
AG-111	Y	1.00	1.0E+00	1.0E+00
CD-113		0.00	1.0E+00	1.0E+00
CD-113M		0.00	1.0E+00	1.0E+00
CD-115	Y	1.00	1.0E+00	1.0E+00
CD-115M	Y	1.00	1.0E+00	1.0E+00
IN-113M	W	1.00	1.0E+00	1.0E+00
IN-115	W	1.00	1.0E+00	1.0E+00
IN-115M	W	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
SN-113	W	1.00	1.0E+00	1.0E+00
SN-125		0.00	1.0E+00	1.0E+00
SN-126	W	1.00	1.0E+00	1.0E+00
SB-124	W	1.00	1.0E+00	1.0E+00
SB-125	W	1.00	1.0E+00	1.0E+00
SB-126	W	1.00	1.0E+00	1.0E+00
SB-126M	W	1.00	1.0E+00	1.0E+00
SB-127	W	1.00	1.0E+00	1.0E+00
TE-125M	W	1.00	1.0E+00	1.0E+00
TE-127	W	1.00	1.0E+00	1.0E+00
TE-127M	W	1.00	1.0E+00	1.0E+00
TE-129	W	1.00	1.0E+00	1.0E+00
TE-129M	W	1.00	1.0E+00	1.0E+00
TE-131	W	1.00	1.0E+00	1.0E+00
TE-131M	W	1.00	1.0E+00	1.0E+00
TE-132	W	1.00	1.0E+00	1.0E+00
TE-133		0.00	1.0E+00	1.0E+00
TE-133M		0.00	1.0E+00	1.0E+00
TE-134		0.00	1.0E+00	1.0E+00
I-122	D	1.00	1.0E+00	1.0E+00
I-123	D	1.00	1.0E+00	1.0E+00
I-125	D	1.00	1.0E+00	1.0E+00
I-129	D	1.00	1.0E+00	1.0E+00
I-130	D	1.00	1.0E+00	1.0E+00
I-131	D	1.00	1.0E+00	1.0E+00
I-132	D	1.00	1.0E+00	1.0E+00
I-133	D	1.00	1.0E+00	1.0E+00
I-134	D	1.00	1.0E+00	1.0E+00
I-135	D	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
XE-122	*	0.00	1.0E+00	1.0E+00
XE-123	*	0.00	1.0E+00	1.0E+00
XE-125	*	0.00	1.0E+00	1.0E+00
XE-127	*	0.00	1.0E+00	1.0E+00
XE-131M	*	0.00	1.0E+00	1.0E+00
XE-133	*	0.00	1.0E+00	1.0E+00
XE-133M	*	0.00	1.0E+00	1.0E+00
XE-135	*	0.00	1.0E+00	1.0E+00
XE-135M	*	0.00	1.0E+00	1.0E+00
XE-137	*	0.00	1.0E+00	1.0E+00
XE-138	*	0.00	1.0E+00	1.0E+00
CS-134	D	1.00	1.0E+00	1.0E+00
CS-134M	D	1.00	1.0E+00	1.0E+00
CS-135	D	1.00	1.0E+00	1.0E+00
CS-136	D	1.00	1.0E+00	1.0E+00
CS-137	D	1.00	1.0E+00	1.0E+00
BA-137M	D	1.00	0.0E+00	0.0E+00
CS-138	D	1.00	1.0E+00	1.0E+00
CS-139		0.00	1.0E+00	1.0E+00
BA-133	D	1.00	1.0E+00	1.0E+00
BA-133M	D	1.00	1.0E+00	1.0E+00
BA-137M	D	1.00	1.0E+00	1.0E+00
BA-139	D	1.00	1.0E+00	1.0E+00
BA-140	D	1.00	1.0E+00	1.0E+00
LA-140	W	1.00	0.0E+00	0.0E+00
BA-141		0.00	1.0E+00	1.0E+00
BA-142		0.00	1.0E+00	1.0E+00
LA-140	W	1.00	1.0E+00	1.0E+00
LA-141		0.00	1.0E+00	1.0E+00
LA-142		0.00	1.0E+00	1.0E+00
CE-141	Y	1.00	1.0E+00	1.0E+00
CE-143	Y	1.00	1.0E+00	1.0E+00
CE-144	Y	1.00	1.0E+00	1.0E+00
PR-143	Y	1.00	1.0E+00	1.0E+00
PR-144	Y	1.00	1.0E+00	1.0E+00
PR-144M	Y	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
ND-147	Y	1.00	1.0E+00	1.0E+00
PM-147	Y	1.00	1.0E+00	1.0E+00
PM-148	Y	1.00	1.0E+00	1.0E+00
PM-148M	Y	1.00	1.0E+00	1.0E+00
PM-149	Y	1.00	1.0E+00	1.0E+00
PM-151		0.00	1.0E+00	1.0E+00
SM-147	W	1.00	1.0E+00	1.0E+00
SM-151	W	1.00	1.0E+00	1.0E+00
SM-153	W	1.00	1.0E+00	1.0E+00
EU-152	W	1.00	1.0E+00	1.0E+00
EU-152M		0.00	1.0E+00	1.0E+00
EU-154	W	1.00	1.0E+00	1.0E+00
EU-155	W	1.00	1.0E+00	1.0E+00
EU-156	W	1.00	1.0E+00	1.0E+00
GD-152		0.00	1.0E+00	1.0E+00
TB-160	W	1.00	1.0E+00	1.0E+00
HO-166	W	1.00	1.0E+00	1.0E+00
HO-166M		0.00	1.0E+00	1.0E+00
HF-181	W	1.00	1.0E+00	1.0E+00
W-181	D	1.00	1.0E+00	1.0E+00
W-185	D	1.00	1.0E+00	1.0E+00
W-187	D	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
RE-187	W	1.00	1.0E+00	1.0E+00
IR-192	Y	1.00	1.0E+00	1.0E+00
HG-203	W	1.00	1.0E+00	1.0E+00
TL-207	D	1.00	1.0E+00	1.0E+00
TL-208	D	1.00	1.0E+00	1.0E+00
TL-209	D	1.00	1.0E+00	1.0E+00
PB-209	D	1.00	1.0E+00	1.0E+00
PB-210	D	1.00	1.0E+00	1.0E+00
PB-210	W	1.00	0.0E+00	0.0E+00
PB-211	D	1.00	1.0E+00	1.0E+00
PB-212	D	1.00	1.0E+00	1.0E+00
PB-214	D	1.00	1.0E+00	1.0E+00
BI-210	W	1.00	1.0E+00	1.0E+00
BI-211	W	1.00	1.0E+00	1.0E+00
BI-212	W	1.00	1.0E+00	1.0E+00
BI-213	W	1.00	1.0E+00	1.0E+00
BI-214	W	1.00	1.0E+00	1.0E+00
PO-210	W	1.00	1.0E+00	1.0E+00
PO-212	W	1.00	1.0E+00	1.0E+00
PO-213	W	1.00	1.0E+00	1.0E+00
PO-214	W	1.00	1.0E+00	1.0E+00
PO-215	W	1.00	1.0E+00	1.0E+00
PO-216	W	1.00	1.0E+00	1.0E+00
PO-218	W	1.00	1.0E+00	1.0E+00
AT-217	D	1.00	1.0E+00	1.0E+00
RN-219	*	0.00	1.0E+00	1.0E+00
RN-220	*	0.00	1.0E+00	1.0E+00
RN-222	*	0.00	1.0E+00	1.0E+00
FR-221	D	1.00	1.0E+00	1.0E+00
FR-223	D	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
RA-223	W	1.00	1.0E+00	1.0E+00
RA-224	W	1.00	1.0E+00	1.0E+00
RA-225	W	1.00	1.0E+00	1.0E+00
RA-226	W	1.00	1.0E+00	1.0E+00
RA-228	W	1.00	1.0E+00	1.0E+00
AC-225	Y	1.00	1.0E+00	1.0E+00
AC-227	Y	1.00	1.0E+00	1.0E+00
AC-228	Y	1.00	1.0E+00	1.0E+00
TH-227	Y	1.00	0.0E+00	0.0E+00
TH-228	Y	1.00	1.0E+00	1.0E+00
TH-229	Y	1.00	1.0E+00	1.0E+00
TH-230	Y	1.00	1.0E+00	1.0E+00
TH-231	Y	1.00	1.0E+00	1.0E+00
TH-232	Y	1.00	1.0E+00	1.0E+00
RA-228	W	1.00	0.0E+00	0.0E+00
AC-228	Y	1.00	0.0E+00	0.0E+00
RA-224	W	1.00	0.0E+00	0.0E+00
RN-220	*	0.00	0.0E+00	0.0E+00
PO-216	W	1.00	0.0E+00	0.0E+00
PB-212	D	1.00	0.0E+00	0.0E+00
BI-212	W	1.00	0.0E+00	0.0E+00
TL-208	D	1.00	0.0E+00	0.0E+00
TH-234	Y	1.00	1.0E+00	1.0E+00
PO-218	W	1.00	1.0E+00	1.0E+00
PA-231	Y	1.00	1.0E+00	1.0E+00
PA-233	Y	1.00	1.0E+00	1.0E+00
PA-234	Y	1.00	1.0E+00	1.0E+00
PA-234M	Y	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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(w 2w 40m set9)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
U-232	Y	1.00	1.0E+00	1.0E+00
U-233	Y	1.00	1.0E+00	1.0E+00
U-234	Y	1.00	1.0E+00	1.0E+00
U-235	Y	1.00	1.0E+00	1.0E+00
U-236	Y	1.00	1.0E+00	1.0E+00
U-237	Y	1.00	1.0E+00	1.0E+00
U-238	Y	1.00	1.0E+00	1.0E+00
TH-234	Y	1.00	0.0E+00	0.0E+00
PA-234	Y	1.00	0.0E+00	0.0E+00
U-234	Y	1.00	0.0E+00	0.0E+00
TH-230	Y	1.00	0.0E+00	0.0E+00
RA-226	W	1.00	0.0E+00	0.0E+00
RN-222	*	0.00	0.0E+00	0.0E+00
PO-218	W	1.00	0.0E+00	0.0E+00
PB-214	D	1.00	0.0E+00	0.0E+00
BI-214	W	1.00	0.0E+00	0.0E+00
PO-214	W	1.00	0.0E+00	0.0E+00
PB-210	D	1.00	0.0E+00	0.0E+00
BI-210	W	1.00	0.0E+00	0.0E+00
PO-210	W	1.00	0.0E+00	0.0E+00
U-240	Y	1.00	1.0E+00	1.0E+00
NP-237	W	1.00	1.0E+00	1.0E+00
NP-238	W	1.00	1.0E+00	1.0E+00
NP-239	W	1.00	1.0E+00	1.0E+00
NP-240	W	1.00	1.0E+00	1.0E+00
NP-240M	W	1.00	1.0E+00	1.0E+00
PU-236	Y	1.00	1.0E+00	1.0E+00
PU-238	Y	1.00	1.0E+00	1.0E+00
PU-239	Y	1.00	1.0E+00	1.0E+00
PU-240	Y	1.00	1.0E+00	1.0E+00
PU-241	Y	1.00	1.0E+00	1.0E+00
PU-242	Y	1.00	1.0E+00	1.0E+00
PU-243	Y	1.00	1.0E+00	1.0E+00
PU-244	Y	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
AM-241	W	1.00	1.0E+00	1.0E+00
AM-242	W	1.00	1.0E+00	1.0E+00
AM-242M	W	1.00	1.0E+00	1.0E+00
AM-243	W	1.00	1.0E+00	1.0E+00
CM-242	W	1.00	1.0E+00	1.0E+00
CM-243	W	1.00	1.0E+00	1.0E+00
CM-244	W	1.00	1.0E+00	1.0E+00
CM-245	W	1.00	1.0E+00	1.0E+00
CM-246	W	1.00	1.0E+00	1.0E+00
CM-247	W	1.00	1.0E+00	1.0E+00
CM-248	W	1.00	1.0E+00	1.0E+00
CF-252	Y	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 16 cm/y
Mixing Height: 1000 m

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SOURCE INFORMATION

Source Number: 1

Stack Height (m): 40.00
Diameter (m): 0.00

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Fixed (m): (Fixed Rise)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.000	0.000	0.000
Fraction From Assessment Area:	0.000	0.000	0.000
Fraction Imported:	1.000	1.000	1.000

Food Arrays were not generated for this run.
Default Values were used

DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT 18310

DISTRIBUTION

MSIN

J. Leitch
United States Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington, 98101

A. W. Conklin
Washington State Department of Health
7171 Cleanwater Lane, Building 5
Olympia, Washington 98504

R. S. Acselrod
Washington State Department of Health
PMB 385
2839 W. Kennewick, Avenue
Kennewick, Washington 99336

Dirk A. Dunning
Oregon Office of Energy
625 Marrian Street N.E., Suite 1
Salem, OR 97301-3742

J. Wilkinson
Confederated Tribes of the Umatilla Indian Nation
P. O. Box 638
Pendleton, Oregon 97801

P. Sobotta
Nez Perce Tribe
P. O. Box 365
Lapwai, Idaho 93540

R. Jim, Manager
Environmental Restoration/Waste Management Program Yakama Nation
P. O. Box 151
Toppenish, Washington 98948

U.S. Department of Energy, Richland Operations Office

M. S. Collins	H0-12
P. J. Krupin (2)	A2-15
C. A. Rodriguez	R3-81
G. H. Sanders	H0-12
G. L. Sinton	H0-12
R. N. Warren	H0-12
Public Reading Room	H2-53

DISTRIBUTION

	MSIN
Fluor Hanford	
W. S. Ayers	T3-28
R. B. Barmettlor	T3-28
B. M. Barnes (2)	T3-28
J. A. Bates	G1-30
B A. Curn	G1-30
L. P. Diediker	G1-27
R. H. Engelmann	G1-30
C. K. Girres	T3-01
J. G. Granger	G1-29
E. M. Greager	G1-29
N. A. Homan	G1-30
J. E. Hyatt	G1-32
D. M. Johnson	R3-13
R. E. Johnson (5)	G1-30
L. D. Kamberg (2)	T3-28
D. Levinskas	T3-28
R. L. McCormack	R3-13
J. L. Miller	T3-28
D. E. Schoepflin	T3-28
J. C. Sonnichsen	G1-30
J. E. Turnbaugh	X3-79
D. J. Watson	X3-79
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